



CARNIVOROUS PLANT NEWSLETTER

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SARRACENIA PURPUREA VENOSA

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EDITORS' CORNER

A hearty welcome to all new subscribers, and an equally hearty welcome back and thank you to our regular subscribers. This is your newsletter, so write in a contribution--a paragraph, a short note, or just a hello.

You will notice a change in our printing format. The print is somewhat smaller in order to put more on a page for mailing weight purposes and so we will not fall behind so far in getting short notes printed. In spite of its diminution, the print should be quite clear since an excellent typewriter with a carbon ribbon was used to make the master. However, we may wish to consider using a double column on each page in the future to make it still easier to read. Let us know how you feel about that, pro or con.

Can't put it off any longer--the apology for the terrible cover photo on the last issue. There was a goof in the gradual conversion to a new printer, and we found out too late that to print a photo with his electrostatic press required an additional intermediate step. The printer was certainly not to blame since CPN is new to him. So, with this issue we think we have improved the photo situation. To offer some balm, we have reprinted the cover photo of Cephalotus follicularis later in this issue. Why change processes? Because with this technique we can print four pictures for the price of one using a standard plate as in the past and get more pictures into CPN as many of you have asked. We are going to see how this issue looks, then lay out the guidelines in the next issue for what is needed in a photo to get it to work with this process. After that, you can contribute pictures as well as words.

Also, there will be no more third class mailings since we have found considerable delay and loss via that route.

We have some especially good things planned for you Volume III subscribers. Joe Mazrimas and Bob Ziemer with the aid of the latter's inimitable computer will be preparing a list to date of all subscribers to CPN, including the dropouts from earlier volumes. Also, Bob is spearheading a rather large group of people, including experts in large individual genera such as Drosera and Utricularia, who are preparing a summary list of all CP species known to date, listed according to "the state of the art" of taxonomy at present. There will be reference to native country or continent and some differentiation of those species listings reasonably known for certain, and the "probably's" and the "maybe's." Both of these lists will be mailed out to Volume III subscribers.

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 DICK SHOOK (230 Pleasant St., Ithaca, New York 14850) is a Cornell graduate student in ethology but maintains a collection of carnivorous plants.
 DR. JURG F. STEIGER (Inselspital 14C, CH-3010, Berne, Switzerland) is studying Pinguiculas of the moderate and alpine/arctic zones.
 ROBERT WILLIAM PATTERSON (Route 3, Wilkins Road, Sanford, North Carolina 27330) is particularly interested in Dionaea.
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JOHN LINDQUIST (118 Bacteriology, University of Wisconsin, Madison, Wisconsin 53706). "I am currently working on a project involving the microbial flora of Sarracenia purpurea. Besides the proteolytic and chitinoclastic bacteria, I have noted several other groups including nitrogen-fixing Klebsiella strains. However, I found no evidence of nitrogen-fixing activity in the pitcher liquid. Presently, I am interested in the function of the "digestive glands", but I have found no definitive papers on the glands of S. purpurea."

CONSERVATOIRE BOTANIQUE BIBLIOTHEQUE (192 Rue de Lausanne, 1202 Geneve, Switzerland).

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NEWS AND VIEWS

KATSU writes that several copies of Rica Erickson's out-of-print book Plants of Prey are available for sale at Foyles, 119-125 Charing Cross Road, London WC2, England.

RICH SIVERTSEN has found that application of rootone to all raw or cut surfaces of Nepenthes cuttings that are to be below rooting medium level (including trimmed leaf bases) drops rooting time to 2-4 weeks. Further, beveling the razor cut lower end of the cutting to a 45° angle exposes more cambium.

STEVE CLEMESHA has some additional information and clarification on his method for propagating Sarracenia rhizomes: "If you cut the rhizome and wish to take out the back piece straight away, it does no harm to do so. Some rhizomes are hard to get at, e.g. S. psittacina hybrids. So to get at it, I take it out of the pot and remove the sphagnum away from it to see if there is enough to cut and if so, then cut and take the back piece and pot it so that it is not covered in sphagnum. When rhizomes grow back, often they make several new shoots so that if you want to divide it up further, you can provided there is a root on each piece. You can cut the rhizome either across or even down the middle. One can use this method to build up good potfuls of slow multipliers like S. x mooreana and S. leucophylla."

WARREN STOUTAMIRE was in Australia last fall and sent these observations on the rather unusual "tuberous" Utricularias: "Utricularia has only a few members which have an accessory organ called a tuber. U. alpina (montana) is one, but another member that grows in Western Australia called Utricularia menziesii also have small rice-grain like tubers. It flowers in the cool, early spring or late winter showing large red flowers or fairy fans as they are called here. The rosettes are usually found around the base of grasstrees (Xanthorrhoea) in fine sand with burned charcoal-like material. They probably dry out slowly but the ground surface must be scorching in the summer heat. They will be wet and chilly (about 50° F.) during winter, with nights occasionally near freezing. They always grow in clumps, with radiating leaves, and usually only show 1-2 flower stems per clump. Unfortunately, I never saw them in flower."

KATSU and PETER TAYLOR noted that there is a species of Utricularia commonly dispersed to various growers. Leaves of this species are polymorphic: some are relatively short and broad, some are very long and narrowly linear, and the others intermediate. This species is identified as Utricularia praelonga St. Hilaire & Girard (syn. U. lundii A. DC., U. polyschista Benj., U. picta Warm.). This living plant was introduced originally to Munich Botanical Garden, Germany, from a locality near Rio de Janeiro, Brazil. Its flowering is very rare.

Regarding the above species, JOE MAZIRMAS reports that his plants are at last putting out flower scapes with small buds at the top. DON SCHNELL is also growing the species but his have yet to bloom. It is possible that allowing the plants to grow to the crowding point and supplying extra light are factors in achieving bloom.

STEVEN TIM says that the Brooklyn Botanic Garden will have a display of carnivorous plants by the middle of this year. They are preparing a case for the plants now. More of the eastern gardens need representative displays of CP that span more than one or two genera. Longwood has an excellent collection of Nepenthes. New York Botanical Garden has a few, but Rich Sivertsen says they are in bad shape.

Several people have written in or asked directly if we are considering organization and a more formal publication. We would like to some day, but economics and numerical support are hard realities. The fact is that at present "everyone" is fascinated by CP but relatively few wish to pursue interest or study sufficiently to help support a society with a more expensive

bulletin or journal. Orchids and bromeliads and ferns and begonias are much more "pop" than CP. These societies number their members in the thousands and collect up to \$15.00 a year for dues and fine bulletins printed on slick paper with excellent color photos. But the interest in CPN has leveled toward the number 200--we would need at least four times that number, all willing to pay a much higher price per year, to even begin to think of expanding into a bulletin or journal format. So, let us continue to try to add to and improve CPN in all ways possible, and take solid comfort in the fact that there is excellent company among our small numbers.

A note of historical interest, DAVE TAYLOR reports that he obtained a copy of Darwin's Insectivorous Plants at local auction and that a notation from the seller indicated that it was originally the property of Lord Herbert John Gladstone, who was the son of the once British prime minister William Gladstone (1809-1898), the book having been presented to the younger Gladstone by Charles Darwin's son Francis. However, Gladstone's interest in CP must have been limited: the pages are still uncut.

SEED AND PLANT EXCHANGE NEWS: The December list mailed to all exchangites lists 21 people and their CP inventories. Bob Ziemer reports that the seed stock of the exchange is at a low point and that the numbers of people inquiring into the exchange is leveling. We would like to urge all CPN subscribers with extra seed or an anticipated production of seed this season to send it on to Bob where it will be distributed to others in the exchange. Likewise, those not availing themselves of the benefit of the computer listing are really missing something. Even if you have no plants to exchange or desire none, send in your list of what you are growing. Besides the exchange of plants and seed, the very fine list can be a source of names and addresses of those growing the same plants as you and with whom you might wish to correspond directly about all sorts of things. The computer listing has capabilities for flagging those plants available for exchange and those not, so your participation in the listing should not involve undesirable pressures as a result. To all those sending in their inventories and list of exchangeable plants (if any) for the next few months, Bob will send a free Darlingtonia and Pinguicula vulgaris plant. Please enclose 50¢ postage (U.S. may send stamps). We think once you see the computer listing, you will be quite impressed. Write: Bob Ziemer, 840 Fickle Hill Road, Arcata, California 95521.

CARNIVOROUS PLANTS HERE AND THERE. A few issues ago, Katsu mentioned that CP had appeared on postage stamps of various countries. We are sure many people have seen the TV ad wherein a highly fantasized Dionaea is avidly consuming the sponsor's potato chips. Also, a recent episode of a popular TV detective series featured "Venus flytrap" in the episode title as well as a metaphor in the story. Finally, we have run across a deck of bridge cards in a shop and on the backs are reproductions of prints of U.S. native plants, including Utricularia vulgaris. We wonder if there is a PR man around we don't know about...

ALLAN MARMELESTEIN has proved to his satisfaction the dormancy requirements of Sarracenias which we have mentioned several times. In the Washington, D.C. area he had been growing S. rubra jonesii and S. oreophila indoors year around since the species are now uncommon. Over two years, they fell into a state of decline and he decided to place them out on a porch where other native Sarracenias were kept year around. During the summer, the two species declined further. When winter came, he neglected to bring the plants in and they were consequently subjected to below freezing temperatures and drying for over a month. Thinking the plants dead but not wanting to throw them right away, he brought them back inside and a little later both species put up new pitchers with vigor he had not observed in them before. The dormancy period was relatively short compared to natural winters in native habitats, but intense, and there is quite likely a minimally sufficient dormancy period far short of that naturally provided. Also, in the same letter, for growing-under-lights buffs, Alan has found that two 75 watt cool-beam incandescent floodlights coupled with fluorescent tubes provides much more coloration. The lamp code is 75 PAR38/2FL and they must be burned in porcelain sockets with adequate ventilation since there is considerable heat passed behind the bulb.

PETER TAYLOR has carefully evaluated Katsu Kondo's key for Utricularia (CPN II:66-69, 1973) and would like to offer the following observations and corrections: (1) The key won't work from the second A as U. olivacea has chasmogamous white flowers. (2) The combination Utricularia standleyae has never been validly made. The plant was described as Calpidisca standleyae. I have never made the formal transference to Utricularia because I am quite sure it is the same as the widespread tropical American U. amethystina St Hil. (despite the supposedly yellow flowers of C. standleyae). (3) I now think that the name U. fimbriata Kunth should be restricted to the plant which occurs only in a small region in the upper Orinoco with long pedicels and tall, many flowered zig-zag inflorescences. The "U. fimbriata" of most authors (including myself) which occurs over much of S. America from Brazil northwards and also in parts of C. America, the West Indies and S. Florida (and tropical Africa) I am calling U. simulans Pilger which is the next earliest available name. (4) Despite what Godfrey and Reinert say, U. radiata does sometimes have a notched tip to the spur. (5) U. australis occurs only from Europe to Japan and Australia with southern extensions into Africa and India. The American plant in question is very near U. vulgaris L. but it has a longer, more curved spur and some other differences, and I prefer to call it U. macrorrhiza Le Conte. Others would

treat it as a subsp. in which case it is U. vulgaris L. subsp. macrorhiza (Le Conte) Clausen. It occurs across N. America and N.E. Asia. (6) U. foliosa L. is common in Florida and extends to Louisiana. I collected it on numerous occasions when I was in the USA a couple of years ago - why is it left out of the key? In other published keys it is associated with U. floridana but now I know that it is not at all closely allied to that. It can be distinguished from all other N. American species by its flattened stolons with two semi-circular series of vascular bundles (all others are terete with a single circular ring of v.b.), the form of its foliar organs and the large flat circular winged seeds.

(In Volume I we listed some commercial sources of carnivorous plants and many readers apparently found this listing useful. So, to update the list and present it to newer subscribers who could not get Volume I after the supply was exhausted, here is the latest. Some firms listed in the older list have been deleted since they no longer supply the plants, and we have added a few. If you know of any more with significant lists, please let us know. As was the case with the first list, we do not editorially endorse any of these sources.)

SOME COMMERCIAL CARNIVOROUS PLANT SOURCES

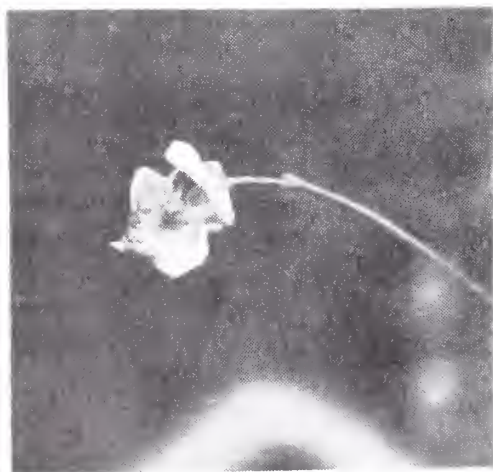
<u>Name and address</u>	<u>Catalogue price</u>	<u>Genera</u>
Peter Pauls Nurseries Canandaigua, New York 14424	25¢	Dionaea, Drosera, Sarracenia, Pinguicula, Darlingtonia, Utricularia, Nepenthes seed
Armstrong Associates, Inc. P. O. Box 127 Basking Ridge, New Jersey 07920	25¢	Dionaea, Drosera, Sarracenia, Pinguicula, Darlingtonia
Insectivorous Botanical Garden 1918 Market Street P. O. Box 3322 Wilmington, North Carolina 28403	25¢	Dionaea, Drosera, Sarracenia, Pinguicula, Darlingtonia
Arthur E. Allgrove North Wilmington, Mass. 01887	25¢	Dionaea, Sarracenia, Pinguicula, Darlingtonia
International Growers Exchange P. O. Box 397 Farmington, Michigan 48024	\$2.00	Dionaea, Drosera, Sarracenia, Pinguicula, Darlingtonia
Peter and Pam P. O. Box 4415 San Fernando, California 91342	Free	Darlingtonia, Dionaea
King's Park and Botanic Gard. Perth Western Australia	\$1.00	Drosera, Byblis, and Cephalotus seeds when available
Carolina Biological Supply Burlington North Carolina	Free list	Drosera, Dionaea, Sarracenia, Pinguicula, Utricularia
Carolina Insectivorous Plants P. O. Box 1245 Greenville, North Carolina 27834	25¢	Dionaea, Drosera, Sarracenia, Darlingtonia, Pinguicula, Utricularia
Thompson & Morgan (Ipswich), Ltd. London Road Ipswich IP2 OBA, England	Free	Nepenthes seeds
Tote Em in Zoo Route 2, Box 368 Wilmington, North Carolina 28401	Free	Dionaea, Drosera, Sarracenia, Pinguicula
Marcel Lecoufle 5 Rue de Paris 94470 Boissy-Saint-Leger France	* \$4.45 each for a rooted cutting of the following: N. x boissiensis, N. kampoiana, N. x dicksoniana, N. x chelsoni, N. x coccinea, N. x williamsii and N. x dormanniana (list varies in time). A free import permit application can be requested from: Plant Importation Office, U.S. Department of Agriculture, 209 River Street, Hoboken, New Jersey.	

* After sending in the completed one page form, you will receive a yellow-green sticker which must be sent to Lecoufle with your order of plants.



CEPHALOTUS FOLLICULARIS

The pitcher on the right is hemisected.



UTRICULARIA TRICOLOR
Photo by Yasushi Sato
(See CPN II:60, 1973)



UTRICULARIA RETICULARIS

SHORT NOTESTHE KALEIDOSCOPE OF SARRACENIA

by D. E. Schnell

We have been asked to record our impressions, hypotheses and observations to date regarding the marked variations we have studied and considered in the genus Sarracenia. These few notes are necessarily brief and telegraphic to fit into the format and intent of CPN, but we would be happy to discuss details with individuals and we are presently engaged in further work with the probability of more formal and complete publication later on. These notes are based on repeated field studies in recorded areas as well as what has been learned by growing the plants under study rather than restriction to herbaria and a "flying field trip" or two.

At the outset, we would emphasize that complete, large scale and accurate field studies of this genus have become severely limited due to wholesale habitat destruction with a resultant precipitous fall in pitcher plant population in locations that were once vast stands of these plants. The loss of natural plant stands in our home state of Carolina is particularly distressing. Further south, into Georgia and the Mobile Bay area of Alabama, pretty good stands remain, but they are severely modified into artificially isolated islands by roads, drainage ditches and pasturing. One then sees an individual or relatively small copse of plants here and there in what once were good grass-sedge bogs, little "gardens" separated off unnaturally. For this reason, serious workers will wish to undertake careful review of the published field notes of older observers who worked in times of less disturbance.

I. Sarracenia flava

This species is rightly described as polymorphic, only S. rubra having at least as many important variations. The variation in S. flava would appear to be mainly in color and venation, although further study may likely turn up consistent anatomic or chemical variations as well. Interestingly, in 1881 Masters (Gardeners Chron., 16:11-12) presented a summary of names and descriptions for many of these forms, but since then formal designations have been discouraged by nearly all modern students. The forms listed in Masters' paper are partially erroneous since they are incomplete and mixed with what are now recognized species or hybrids, but we accept his basic intent as sound.

We believe one cannot simply dismiss these variations in S. flava as of minor interest or "just mutants." In light of current concepts, polymorphism in a species is certainly not casual. Polymorphism implies disruptive selection, an active evolutionary and ecologic process. The fact that these forms appear recurrently in considerable numbers in colonies of S. flava over nearly its entire range (although they are more often found in the range center), clearly indicates that they are not being "swamped" or absorbed into the gene pool as one would expect a simple, local genetic accident to be. Since they persist, we must seriously consider that they possess some selective advantage. This advantage need not necessarily lie in the vein and color variation itself (although this would have to be ruled out), but the morphologic variations may just be riders on chromosomal segments that offer physiologic advantage in some microvariation of habitat. To define such a possible habitat variation will require some study since to all appearances they grow mixed in with the typical form of S. flava, side by side in what would on the surface appear to be the same uniform habitat. If the habitat is indeed not significantly variable in relation to the precise positioning of these forms in a polymorphic colony, then perhaps directional selection is actually beginning to occur. We have noted grass-sedge bogs that have become artificially partitioned by roads, ditches and agriculture in which the "lesser" forms were actually dominant over the species typical forms in these instances of enforced isolation. Also, although difficult to judge in the field in colonies where the non-typical forms may be relatively few, flowering seems to be less; but growing plants of the variants in the greenhouse indicates that they do flower and produce viable seeds.

For these reasons, and for the purpose of communication, we would like to see these variants designated formally as forms, but certainly not as subspecies yet since they are all mutually sympatric. Tentatively, we recognize the following four basic forms:

1. The most common and "typical" one, having yellow or green lid (depending on sun exposure) with a prominent, irregular maroon pigmentation on the inside of the lid stalk, and slight to moderate venation radiating superiorly and inferiorly from the color spot. The only form present in relic piedmont bogs which may be of some phylogenetic significance and which we will consider in a later note.
2. The second most common form, having two types of rather diffuse maroon or deep red color to the pitcher:
 - a. Red or maroon (or a coppery color if grown in less than full sun) of the external surface of the lid rather than green or yellow, lid stalk color spot present with moderate venation.
 - b. Red or maroon of the top of the lid and externally extending nearly all the way or entirely to the rhizome.

(Intermediates of a. and b. noted -- Crosses?)

3. A rather striking diffusely deep yellow or gold pitcher with very heavy, prominent red veins over the entire pitcher and lid resulting in a reticulate appearance with intervening patches of leaf puckering out between the vein net. Maroon pigment spot of inner lid stalk reduced.
4. A moderately uncommon anthocyanin-free form with pale green or yellow pitcher (cf. heterophylla form of S. purpurea).

As one observes many colonies over the range, one can easily note what empirically would seem to be crosses between these forms as well as with the typical forms, but laboratory pollination experiments will have to be completed to elucidate this as well as to illustrate if the above listed forms are actually irreducible. We have examples of these forms as well as putative field crosses under laboratory cultivation (and continuous observation in the field) and are beginning crossing experiments as well as self-pollinations to ascertain segregation of offspring and to see if the four basic forms are indeed absolute.

There is not doubt upon carefully considering all these specimens that they are of the taxon S. flava, and that they are not complexly introgressive hybrids with other species of the genus. The observation that the vein and color differences often fade to some degree when the plants are moved to tubs or greenhouse does not detract from the original thesis of genetic difference: How a plant may vary in different environments as compared to other members of the species which may vary differently or not at all in transplanting, is still likely biologically significant. One must remember that transplanting these forms may be introducing them to less than an ideal environment for expression of their full genetic complement. Actually, these cultural variances would seem to point more toward as yet undetected variations in microhabitat being important in the disruptive selection process.

II. Sarracenia purpurea

We concur with Wherry's original conclusion that the northern (S. purpurea purpurea) and southern (S. purpurea venosa) variants of this species do indeed deserve subspecific status. Except for the overlap area in New Jersey (the true nature of the overlap factor often passed over by critics of this proposal), the differences of pitcher form and tomentose condition, biological response to different climates and habitats on transplant, as well as the important ecologic difference of playing host to larvae of two different species of Wyeomyia with the insects "following" their hosts through the overlap area, are sufficiently consistent in our opinion and experience to warrant the formal subdesignation. (Plants of the species in the southern Appalachian mountains often assume an intermediate morphology between the two subspecies. These plants are venosa with ecophenic changes that disappear on reciprocal transplant.) Homogeneous environmental transplant experiments often result in plants assuming a tendency toward each other in appearance depending on the nature of the transplant environment, but there is never a total transformation according to our observations. Actually, the two subspecies may be considered extremes of a huge north-south (nearly transcontinental) cline, with some expected genetic intermingling at the central interface, not surprising considering the promiscuity of all Sarracenias. Since the two ends of the cline are obviously allopatric, subspecies is warranted over form. We have crossing experiments underway to determine the relative dominance of the subspecific characters.

But S. purpurea varies still more with three good forms to be considered under the appropriate subspecies:

1. Forma heterophylla--already formally described and well discussed in several papers.
2. A rare venosa variant mentioned by Wherry (Mobile Bay) and Bell (N. Florida) with pale pink petals, white style expansion, and green leaves. This variant has not been re-found in the past twenty years to our knowledge and it certainly needs to be searched for and studied. Since current locations are not known, we rely on imperfect herbaria preparations, past descriptions, and make the perhaps unwarranted assumption that the plant is not some interspecific hybrid.
3. A diffusely deep red or maroon venosa occurring in colonies throughout the southern range, mainly the coastal plains, and more particularly on the Atlantic side. Our argument for this plant as a form would follow the same argument as the case for S. flava (v.s.). With Bell, we have noted that the plants tend to occur as a monoformic colony rather than evenly or inferiorly mixed with typical venosa, although occasional veined forms are found in maroon colonies, and apparent crosses between the two noted. But the maroon is only very rarely found as an occasional in a typically veined colony. Contrary to previous reports, even when shaded in deep summer grass, we have noted that newly sprouting pitchers in the late summer are still deeply and uniformly pigmented and remain so to maturity. We have not noted fading of these shaded later pitchers in natural areas, provided one is observing a pure maroon form with no evidence of venation in older pitchers. In culture, though (in very wet sphagnum), the plants do need full sun to retain the deep color, but control plants of veined forms do not become so deeply red under like conditions, indicating genetic differences. One wonders what drier conditions and/or the particular constituents of the sandy coastal plain soil may play in expression of the maroon trait.

III. Sarracenia leucophylla

We have not perceived any other forms than those well known:

1. Those plants with a pure white top (green veined), large lid and flaring pitcher opening. "Typical" form.
2. Plants with varying degrees of pink to red venation with very pale pink pigment spilling into the intervenous portions, smaller, more flexed lid, and somewhat narrower mouth. Caution is called for here since the species hybridizes readily with the western sympatric S. alata, but we believe we can sort these hybrids and back-hybrids. Still, introgressive hybridization as a mechanism in formation of this form cannot be ruled out and is likely.

IV. Sarracenia alata

This species is sympatric with S. leucophylla over most of both ranges but extends farther west. As above, varying degrees of hybridization are a problem, but we believe there are two main forms:

1. A largely green form with moderate venation (in sunlight) of the upper portions of the pitcher, pitcher form and flower otherwise characteristic of formal S. alata species descriptions. This form is most common in the eastern portion of the range.
2. A form with decreased venation but deep red or maroon pigmentation primarily of the lid and upper pitcher interior, extending externally in large plants in full sun. These forms are more common from Biloxi west, although there is wide intergrade, and the colonies in sloping wet meadows are very striking.

V. and VI. Sarracenia minor and S. psittacina

We are considering these two together since in our opinion there are no recognizable morphologic forms confirmed in either species. There remains the interesting and oft cited problem of the very large plants of these two species on the "prairies" of the Okefenokee. It has been said, although I cannot find detailed documentation, that samples of these plants removed to outside locations and greenhouses quickly assume ordinary size. What is lacking, of course, is the reciprocal part of such an experiment without which the unilateral results are meaningless: the placement of smaller coastal plain plants of each species from various areas into marked Okefenokee sites for observation. The simple waning of Okefenokee plants in greenhouse and other culture means nothing until the capabilities of both source plants are reciprocally studied. If the difference in size then proves to be ecotypic rather than ecophenic after all, then of course even this capability of the Okefenokee plants to be larger in home habitat would have clear biologic significance in spite of what happened to the plants in an outside environment which for the plants might be suboptimal for expression of the size trait. The Okefenokee plants seem to flower quite abundantly, by the way, so we doubt if there is a "ploid" involved. As an aside, we have noted that largest plants of S. minor removed from Cardina coastal plain sandy soils (summer drying) and grown in wet living sphagnum in the greenhouse under bright light become more robust (after two years or so to catch up over transplant setback) than in the original location or control plants in coastal plain soil grown beside the sphagnum tubs.

VII. Sarracenia oreophila

We will pass on this species for the time being, yielding to our friend Randy Troup whom we expect will be telling us of his continuing, lifelong observations soon, and who certainly knows more of the variations and temperament of this species than anyone we know of.

We would like to make one comment though. Contrary to previous published observations, we have noted a definite "feline" or "musty" S. flava-like scent in flowers of this species from at least two locations. Steve Clemesha, growing the plants in Australia, concurs. The plants were otherwise typical S. oreophila in all respects. The strength of the flower scent is about 25% that of S. flava. Although out of place but somewhat appropriate here, we might mention that we have also noted a strong, similar scent in S. alata flowers from many locations and in both color forms. Here the strength of the odor is stronger, about 70% of S. flava. Since these species are all widely allopatric, there is no chance that any were S. flava or flava hybrids. This flower scent was noted in freshly opened (which may be the reason it was missed before in field plants) flowers in the field as well as in the greenhouse. The scent character of the flowers as well as flower color and some aspects of pitcher forms suggest a close phylogenetic relationship between these three species. However, placement of these three plants as subspecies under one species would be a severe phylogenetic and taxonomic error.

VIII. Sarracenia rubra

This is one of the most fascinating "species" upon which one can speculate regarding biology, form, geography and phylogeny. Again, space precludes a rational development of thesis here, but we are beginning to consider that the lowland plants of S. rubra may more nearly approximate the primordial plants of the species than the upland jonesii plants. If indeed prior to

the tertiary uplift some 60 million years ago the present southeastern mountains and piedmont were a vast peneplain similar to the present coastal plain, dotted with bogs and laced with slowly moving waterways, then one might suggest that the plants "descended" from the now higher lands to the coastal plain after the uplift could be the ones following a more compatible environment while the mountain form was able to remain because of physiologic adaptations and selection to the now colder habitat; and likely through isolation over such a long period it underwent further evolution. Thus, in this early pre-uplift bog-plain, there may have been the condition of disruptive selection that we presently see with S. flava and that probably exists with other Sarracenias as well, the selection then becoming locally linear as habitat demanded. Of course, it was clearly serendipitous that a variant capable of survival was present when needed, and one wonders how many other early Sarracenias have come and gone during ancient environmental upheavals. There is some present biological indication of this hypothesis: Typical lowland S. rubras of the Carolina coastal plain will not grow or develop as well outdoors in mountain or piedmont bogs, the plants becoming stunted and juvenile. On the other hand, the mountain plants will not do as well in the warmer environments, although they will survive.

Therefore, in light of true morphologic differences (in fully developed plants in all cases), geographic isolation and important biologic variances, we certainly agree with Dr. Wherry's current suggestion of subspecies status for the mountain plants (jonesii). But, viewed in the overall perspective of the genus Sarracenia and S. rubra as an acceptable taxon, species designation would not be appropriate. The fact is the mountain plants are still more like S. rubra than unlike it. Contrary to previously published reports, there is a very strong violet-like scent to the flowers of jonesii, as in the Atlantic coastal plain plants of S. rubra. Also, we would disagree with previously published concepts of intermediate and lowlands pitcher forms occurring as taxa in the mountains. Observation of growing plants indicates that such pitchers are a natural occurrence in maturation of the jonesii plants, the pitchers being juvenile. The fact that juvenile pitchers of jonesii resemble so much the mature pitchers of lowlands S. rubra would further indicate that the mountain plants are more evolved.

There remain variations in the lowland plants. We are still studying the two color-vein variants in the Atlantic coastal plain and sand hills, the plants tending to occur in mixed colonies: One reticulately veined over a tan to green-tan background of lid and upper pitcher, the other with veins less prominent and with a rather diffuse red color of the outer lid and upper portions of the pitcher but with a lighter tan, still veined lid inner surface. These forms are clearly genetic as evidenced by their occurrence in mixed colonies and retention of characters in various transplants. We have found that relative scape length is extremely variable, certainly more so than pitcher characters, as any form, species and subspecies is moved about. Herbarium specimens, of course, could not indicate this but living with the plants certainly does.

Finally, there is the fascinating plant of the Gulf coast which reaches its zenith in western Alabama but can easily be found in western Florida and was once suggested to be a displaced portion of jonesii range. This it is not. The plant is moderately tall, the rubra odor of the flower is absent, the adaxial ala is not as strong as lowland rubras but still more prominent than a well-developed jonesii pitcher, the lid is more reflected away from the pitcher opening (which has a different shape) with the stalk of the larger lid somewhat reflexed, and there is not quite the bulge-like dilatation of the upper pitcher as in jonesii, the contours of the pitcher being smoother. There is more diffuse red pigmentation admixed with fine venation and the lid is frequently somewhat undulate on the margins. These characters follow in transplants. This variant is still under study and at present we have no conclusion regarding its taxonomic status which ultimately could fall anywhere from a rubra form (lack of flower odor and lid differences are disconcerting) to a separate species.

In the lowland plants of S. rubra one can see much ecophenic variation clearly related to water supply and planting medium. The drier sandy savannahs tend to produce small, almost juvenile pitchers even at flowering age, while the sphagnum filled roadside ditches and wetter bogs and bays produce larger, more robust plants. Reciprocal transplants confirm this impression. These variants obviously do not deserve taxonomic status.

HOW TO GROW ALDROVANDA VESICULOSA

by Mr. Ohtaki and Mr. Katagiri .

Aldrovanda is a delicate aquatic plant which grows under very narrow environmental conditions. To be successful, certain conditions must be carried out in order that the plant continues its rapid rate of growth. Such conditions are:

1. Observation: You must observe your plants closely especially with respect to the shape of the growing point. If the growing point is rounded and onion-shaped, it is in quite good condition. If not, you should change the whole water soon, and trace the origin of the failure. The acidity of the water is very important and should be checked daily with either indicator dyes or pH paper which can be purchased in tropical fish stores. This species is much more sensitive to pH changes than the genus Utricularia. Under quite favorable conditions, Aldrovanda increases rapidly by branching, about eight times a month, and grows at the rate of seven to nine nodes per ten days. The optimum range

of pH or acidity level is 6.4 - 7.0.

2. Outdoor culture: Into a large water lily basin, made large as possible, place a layer of acid soil and plant various water plants such as Iris laevigata, Typha latifolia and Sagittaria. Fill the water to a depth of eight inches. Set up this basin in full sunshine and leave it alone for one to two months to observe if the above plants are growing well and the water becomes clear. It is then suitable for growing Aldrovanda. One may also use dead plant material of either rice stems or that of Phragmites or Typha when available. The stems are chopped into two-inch length, and one to two handfuls of dead material are added per gallon of water, and this is repeated three times a month. An excess of dead material is not damaging and if the water turns yellowish like beer, it indicates acidity and is good for the plants. If the water color turns blackish, it indicates the water is bad and needs changing soon.
3. Indoor culture: This method makes use of a tropical fish aquarium which should be large as possible into which one puts a layer of fine river sand that's acid in nature. Add rain water or distilled water for best results, but if you use hard city water, the pH must be corrected to about pH=6 by adding dilute sulfuric acid and leaving it alone for a few days. We have inexperience in the use of distilled water but it is possible that diluted Knop solution (1/10) produces good results. Aeration should be used using an aerator that produces fine bubbles to keep the water constantly refreshed. The temperature should be kept at 80° F. and not over 90° F. A plant-growth light like Gro-lux should be used for best results since insufficient light causes weak growth. If you wish, a small amount of Daphnia (living water flea) should be added as food for Aldrovanda. An excess amount will contaminate the water. Brine shrimp could be experimented with but the excess chloride ion is detrimental to the species. Chopped rice-straw should be added to the water as fertilizer. The aquarium glass can be cleaned naturally by adding pond snails or Red snail, paper shell as you do in an ordinary fish aquarium. If algae, as Spirogyra is present, it should be removed by tweezers as much as possible. It inhibits Aldrovanda's growth and means that the pH of the water is changing into the alkaline range. Although burnt Alum (Aluminum oxide) kills algae, it is not a desirable means of controlling it.
4. Supplementary information: In the outdoor culture, water levels decrease by evaporation and a fresh supply of water should be added from a watering can every evening. Consequently, the water is partially renewed with good results. When the plants fill the total surface of the water, they stop elongation by branching. At this time, the culture should be divided into two portions for use into another container. It is due to secretion of an organic acid by the plants which inhibits growth at this stage.

Typha latifolia = broadleaf cattail Sagittaria = arrowhead

GROWING DROSERA AURICULATA

by Leo Song

In the fall of 1972, I received several dormant tubers of Drosera auriculata. These were immediately planted in a mix consisting of 2:2:1 parts by volume of peatmoss, #20 quartz sand and decomposed granite gravel (1/8-1/4 ins.) respectively. Supplementary fertilizer in the form of bonemeal and dolomite powder was added at the rate of 1 level tsp/gal mix. The tubers were planted about 1/2 inch deep and watered thoroughly with distilled water. They were then placed in the lath house and no attempt was made to protect them from frosts or rains (California).

By about February of 1973, one of the tubers had sprouted and by mid-March, was in flower. By this time a second tuber had sprouted. The second one was in flower about May and was smaller - only one flower and seedpod being produced. Meanwhile, the first plant produced three flowers and three seedpods and they apparently were self-fertile. When the seedpods on the plants have ripened, I decided to check on the progress of tuber formation. (See CPN 1 (4): 59) By carefully digging down beside the stem, I encountered the old tuber and the stem of the "dropper" which led to the new tuber about 1/2 inch lower.

According to Vickery (1933), this is the method by which tubers work their way down into the ground. The tuber is actually formed at the apex of a generally downward growing stem (the "dropper"), which after growing downwards for a given distance, the growing tip then becomes inverted (facing upwards) and begins to swell. After reaching a certain depth, the tuber for the following year is produced beside the old tuber on a very short "dropper" stem. In most cases, then, the old tuber is exhausted and eventually dies, but the new tuber takes over next year. Formation of the new tuber depends on favorable conditions. The new tubers on my plants were slightly larger than the old ones, both being about 1/4 inch in diameter. The pot is now set aside and kept dry until fall rains. Several tubers didn't sprout last time but they are apparently alive with at least one producing a tuber on one side.

Literature reference: Vickery, Joyce. 1933 Vegetative reproduction in Drosera peltata and D. auriculata. Proc. Linn. Soc. N.S.W. (Australia) 58, 245-269.

DROSERA ARCTURI

by Peter Müller

In the spring, the plants begin to come out of their long rest period that has taken them through winter. The first thing that they must do is to put out new leaves to replenish their depleted supplies of nutrition. The first leaves are rather poor and comparatively small, but soon the plants manage to put up some long healthy and deadly leaves. Then, about halfway through spring, small flower buds begin to appear. After a period of about 2-3 weeks, the plant has caught sufficient food to carry on pushing the newly formed flower buds on up to the light. When the flower stalk has stretched to a length of about 2-4 inches, small buds appear to elongate and within a short time they open. Usually, depending on the soil and light, the flowers are white in strong light and in partial shade appear to be violet or purple and white.

In summer, depending on whether the flowers have been visited by pollinating insects, the seed pod will begin to swell. If not pollinated, the flower turns brown and wilts. After three weeks, the seeds are mature and ready to be distributed among the surrounding bush and begin a life of their own.

In autumn, the plant needs to store up as much food as the plant can for the long winter. Many insects meet their end on the deadly leaves of this species. The small basal area where the feeble root system leads out into the soil becomes rather fat and round. In some cases, the plant cannot get enough food and the plant does not emerge during the following spring. But this happens very seldomly and only under very extreme conditions.

In winter, the quiet period just before deep winter sets in, a few leaves come out. They begin to yellow and lose interest in catching insects. Soon there is nothing to be seen but a few twisted, brown leftovers from the prosperous summer. The plant is now entirely below ground and frequently covered with snow and no one knows where they are hidden until the following spring when they show their intriguing leaves again.

ON NAMING THE CYTOTYPES OF THE DROSERA SPATHULATA COMPLEX

by Katsuhiko Kondo

The Drosera spathulata complex consists of five cytotypes reported: $2n=20, 40, 50, 60, 80$. Each of them is isolated geographically. A cytotype of the diploid form grows in New Zealand. The tetraploid form grows in eastern Australia, up to Yakushima Is., and in the Kanto District in Japan. The latter (tetraploid; Kondo, in press) is called the Kanto type. Around Kansai District and southwestern Chubu District there is another cytotype, the hexaploid Drosera spathulata, which is called the Kansai type. The pentaploid Drosera spathulata Kobayashi seems to be of hybrid origin and is not common to nature. The octoploid Drosera spathulata is called Drosera aliciae at the present time. These cytotypes show differences in quantitative characters but not much difference in morphological characters. Petal color differences (e.g., white or pink) do not mean anything. Thus, subspecies, varieties, or form designations would not be necessary to taxonomically rank each cytotype.

The problem is there are five cytotypes of the Drosera spathulata complex; perhaps additional cytotypes will be found. If these cytotypes are ranked taxonomically and are named now, they would be confused by different people in the future: a different cytotype does not mean "different subspecies", "different variety" or "different form" taxonomically.

For growers, the following names are recommended at present:

- (1) D. spathulata from New Zealand (diploid) - New Zealand type
- (2) D. spathulata from Australia, Yakushima Is. (Japan), Kanto District (Japan) (autotetraploid) - Kanto type
- (3) D. spathulata from Japan (allopentaploid) - Kobayashi type
- (4) D. spathulata from Kansai District and southwestern Chubu District (allohexaploid) - Kansai type
- (5) D. spathulata from unknown locality (octoploid) - D. aliciae

There is a hybrid of Drosera spathulata, horticulturally named D. x 'Nagamoto', which was made by Mr. Jiro Nagamoto. The parents of the hybrid were Drosera longifolia (anglica) as the maternal parent from Hokkaido and D. spathulata as the paternal parent from Mt. Shinoda, Osaka (the Kansai type). This hybrid might join with the Drosera spathulata complex.

SARRACENIA IN SYDNEY, AUSTRALIA

by Steve Clemesha

Here in Sydney we are fortunate enough to be able to grow the genus Sarracenia out of doors and also to be able to water them with tap water as our tap water lacks minerals which kill Sphagnum and other acid loving plants. My plants all grow in plastic pots of peat and/or Sphagnum and these stand in water saucers. They do best in open sunny position. I once grew them in a sunny place where tree branches hung over them even if some were 40 feet high. A type of grub which bores into the trees used to fall from these and bore into Sarracenia rhizomes and buds, often nearly killing a plant. This problem ended when plants were moved to an open position.

There is no local source of the plants so all must be imported from the U.S.A. This can be done either as seed or plants. As plants are set back about a year and have to spend three months in a quarantine nursery, seed is preferable where there is a choice, especially as in this genus as the seed holds its viability for about two years.

I raised plants of Darlingtonia from seed to flowering in four years. I then foolishly put the plants in a specially prepared bed where they died. As mature imported plants failed to survive reversing of seasons there was nothing else to do than to start again from seed. This I am doing now and shall be much less hasty to experiment with this species. It seems to require full open sun right from the start and is best in peat when small because sphagnum moss tends to overgrow it. When it grows larger, it can be topped with sphagnum. I have given numerous plants of it away, and no one has succeeded with it who has given it shade.

S. purpurea is the first species of the genus I tried to grow and it is by far the most difficult. Mature plants I attempted to import failed and all others have been raised from seed. For the first two years when the plants produce narrow juvenile pitchers, they are trouble free. When mature pitchers appear in the third season, they continue well. It is in the fourth season that is their "Waterloo." In periods of dry wind or heat which do not harm hybrids or other species, one will find one or more pitchers have dried or collapsed. This continues until the weakened plant rots. Southern forms are no more resistant than northern forms. The problem even affects the hybrid S. x catesbei but to a much lesser degree and only in rare extremes of heat. This summer I will place four sticks around the pot and over these I will put a polyethylene bag with the top cut out. The plant is then in a more humid and wind-free atmosphere. This method works with some Droseras which seem wind sensitive. I may need to give the plants more shade to compensate for the extra heat in the bag. S. psittacina responded very well to this treatment. Use of the bag has stopped pitcher die-back and more vigorous growth has resulted. This year the pitchers have survived the winter in full beauty and for the first time I have a plant in bloom.

S. minor is another one I had trouble with as my first plant of it rotted. Don Schnell advised to give as much sun as possible for this plant and with this I agree. I also make sure that the rear end of the rhizome is cut off clean and through live "wood." In potting the plant I make a little hill in the center. I have the rhizome sitting on top of this with the scar exposed to the sun. This way the plant grows well and without trouble and this year for the first time one will flower.

S. rubra--I have four clones of this species including one of forma jonesii from Etowah, North Carolina. These now grow easily and well but grow only in much sunlight or else rot will break out on the underside of the rhizome in shade.

S. flava is a species I grow easily and without a problem though I have yet to see a flower on it. I suspect I was not giving it sufficient sun. Under my conditions it does not produce a red patch under the hood or any flat leaves in late summer and autumn.

S. alata is very easy and flowers each year. One clone I have has a tendency to form more leaf blade than the other. The less "leafy" one may be a hybrid but now it is in bud, so soon I will know.

Both S. oreophila and leucophylla also grow easily, but the former plant does not produce off-sets, or flowers in the shade.

SPECIAL NOTICES

We have received many queries for back issues of CPN and regret that our supply is exhausted. We print just enough issues to cover current subscribers plus a fair estimate of new subscribers who may come along during the course of a volume so they can receive a complete volume if at all possible. We realize that there may be losses of one or more issues that people will wish to replace and in these instances we will Xerox copies from our personal issues at cost which runs about 5¢ per page. We do not plan reprinting CPN's as such, but after Volume V or so is complete, we would like to make up a series of booklets covering all of the pertinent material in the previous five years of CPN. There would be one booklet per genus (sometimes

two or more genera if volume of material is small) plus a booklet with all the literature since Lloyd listed in bibliographic fashion with a line or two on what the paper is about and its relative merit. The genus booklets would contain all of the short notes on that particular genus in addition to the timeless News and Views paragraphs collated by authors so that you can follow what each individual had to offer over five years. We also plan a plus--summary articles on culture where these have not been presented by the end of Volume V.

JAPANESE CARNIVOROUS PLANT BOOKS

Once again, we are providing CPN members with the opportunity to order CP books published in Japan. They are written in Japanese but many of them are generously interspersed with excellent pictures both in color and black and white of many species of CP. We understand that many of these books are nearly sold out despite the fact that several of them are in second or third printings! So, while the limited supply lasts, we can offer the following books at prices that include all postage (overseas and domestic). Please send your check or money order to J. Mazrimas (in his name) before May 1, 1974. There will be a delay of two months or more before you receive the books that you ordered.

<u>Author</u>	<u>Title</u>	<u>Pages</u>	<u>Price</u>
Shimizu	Insectivorous Plants (Photo Illustrated)	154	\$11.00
Suzuki	Insectivorous Plants (Cult. and Coll.)	168	\$ 2.00
Shimizu	The Mystery of Carnivorous Plants	54	\$ 3.00
-----	<u>Aldrovanda vesiculosa</u> at Hanyu-city	32	\$ 2.50
-----	"New Flower" magazine special edition	86	\$ 1.50
Kondo	Carnivorous Plants	292	\$ 6.00
Komiya	Syst. Studies on Lentibulariaceae (Eng.)	124	\$ 8.50

RECENT LITERATURE

- Bezanger-Beauquesne, L. and Perrin, E.: Comments on Drosera. Plant Med. Phytother. 6(3): 183-193 1972
D. ramentacea Burch. is the most important commercial species of Drosera since extracts from this species are still of therapeutic value, especially in bronchial spasm.
- Ceska, A., Bell, M.A.M.: Utricularia in the Pacific Northwest. Madrono 22(2): 74-84 1973
 Five species of Utricularia, i.e., U. vulgaris, intermedia, ochroleuca, minor, and gibba are reported in the Pacific Northwest, U.S.A. U. occidentalis was found to be a synonym of U. ochroleuca. Keys are given for all the species mentioned.
- Ellenberg, Heinz (ed.): Ecosystem research. Results of Symposia of the German Botanical Society and Society for Applied Botany. Innsbruck, Austria 1971
 One chapter in this 280 page book describes the production and pigment analysis and gas exchanges of Utricularia vulgaris in a steppe lake.
- Jay, M. and Lebreton, P.: Chemotaxonomic research on vascular plants. XXVI The flavonoids of the Sarracenaceae, Nepenthaceae, Droseraceae and Cephalotaceae; critical study of the order Sarraceniales. Nat. Can (Que) 99(6): 607-613 1972
 A comparative chemical study was made of the leucoanthocyanins, flavonols, flavones and ellagic acid of the carnivorous families mentioned above. From this survey, it is obvious that the Sarracenaceae and Nepenthaceae are related and it is interesting that these two families are distantly related to Droseraceae and Cephalotaceae. The family Cephalotaceae should be placed near the Saxifragaceae and the Droseraceae family is related with the Parietales.
- Kondo, K.: The chromosome numbers of four species of carnivorous plants. Phytom 31(2) 93-94 1973
 The chromosome numbers of four species of carnivorous plants were reported for the first time: Heliophora minor (2n=42), Pinguicula planifolia (2n=32), Utricularia racemosa (2n=36, and Utricularia tricolor (2n=28).
- Mohan Ram, H. Y., Harada, H., Nitch, J.P.: Studies on growth and flowering in axenic cultures of insectivorous plants: III. Effects of photoperiod, ethrel, morphactin and a few other growth substances and metabolic inhibitors on Utricularia inflexa. Z. Pflanzenphysiol. 66(3): 235-253 1972
 Shoot tips grown in White's basal medium with sucrose and iron-EDTA developed flower buds when exposed to 7 short days followed by normal growing conditions. The compounds ethrel, BA, ABA and kinetin promoted flowering under non-inductive conditions. Other drugs caused malformation.
- Taylor, Peter.: Flora of Tropical East Africa: Lentibulariaceae. 20 pages.
 Thirty-four taxa in Genlisea and Utricularia are described, with synonymy and distribution records.

Wood-Baker, C.S.: A New food-plant for Acyrtosipon pelargonii borealis H.R.L. in north Britain, with biometric data. Entomol. Mon. Mag. 108: 95-97 1972

Drosera anglica was found growing in depressions around a small lake. Some leaves had moderately large, light green apterous aphids feeding on the underside of the lamina. It seems this aphid adapted to this plant since it was not found on other plants in the area.

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Stephen Williams sent in the following:

"Queen of the marsh imperial Drosera treads

"Rush-fringed banks, and moss-embroider'd beds;

"Redundant folds of glossy silk surround

"Her slender waist, and trail upon the ground;

"Five sister-nymphs collect with graceful ease,

"Or spread the floating purple to the breeze;

"And five fair youths with duteous love comply

"With each soft mandate of her moving eye.

"As with sweet grace her snowy neck she bows,

"A zone of diamonds trembles round her brows;

"Bright shines the silver halo, as she turns;

"And as she steps, the living lustre burns."

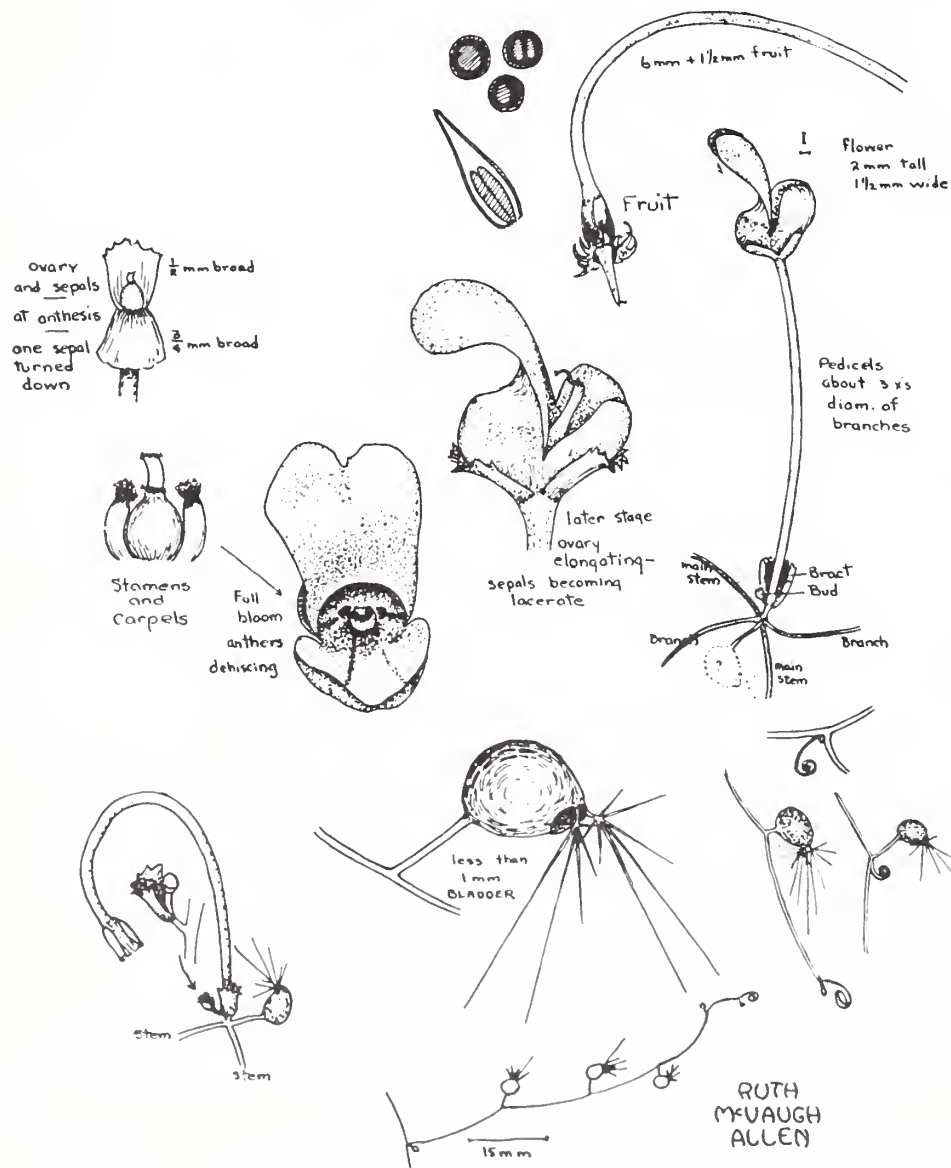
-The Botanic Garden
Part II: The Loves of the Plants
Erasmus Darwin. London, 1799.

CARNIVOROUS PLANT NEWSLETTER

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UTRICULARIA OLIVACEA.

Dr. Wherry gave us permission to reproduce this earliest sketch of the species from Barton (No. 29, 1958).

The sketch illustrates some points Dr. Wherry makes in an article within.

NEW SUBSCRIBERS

KATSUHIKO NEGORO (B-212 Marubeni-Komazawaso, 2-37-10, Komazawa, Setagaya, Tokyo, 154, Japan).
 YASUO KISHIMOTO (15-11, Tokiwa-Kandacho, Ukyoku, Kyoto-City, 616, Japan).
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 KATSUFUMI ITO (Higashishizimi, Jyushiyama-mura, Ama-gun, Aichi Pref., 490-14, Japan).
 SHIGETOSHI YAMANAKA (5-18-15, Okusawa, Setagaya-ku, Tokyo, 158, Japan).
 DOUGLAS WITKOWSKI (5240 NE 17 Terr, Ft. Lauderdale, Fla. 33308) mentions that there are about seven species of Utricularia reported in Florida, but he has been able to locate only three: U. inflata, U. cornuta, and U. subulata.
 PROF. DR. C.D.K. COOK (Director, Botanical Garden and Inst. for Systematic Botany, Univ. of Zurich, Zurich CH-8039 Switzerland) says the garden is open to the general public and is used for teaching and research. He has a fairly large display of CP with all genera except Genlisea and Polypompholyx, for which he is looking for material.
 ROBERT BLACK (Fisheries Research Board of Canada, Biological Station, St. John's, Newfoundland A1C 1A1) is planning some field work in studying the relationship of Sarracenia purpurea with the insects it catches.
 TSUTOMU OHASHI (3-37, Toyochō, Handa-City, Aichi Pref., 475, Japan).
 TOSHIWO KANAGAWA (Oaza-Mitsune, Hachijo-machi, Hachijo Isl., Tokyo, 100-15, Japan).
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 RUDI GRIMM (6111 Otzberg 6, Zu den Steinbruchen 9, West Germany).
 GORDON W. DILLON (54 Jason Street, Arlington, Mass. 02174).
 KATSUYUKI YOSHIMURA (266-7 Mine-Machi, Utsunomiya City, Tochigiken, Japan).

NEWS AND VIEWS

CARL FORST reports on what amounts to the first regional meeting of people interested in carnivorous plants since the inception of CPN. The meeting was hosted by Jim Doty of LASCA and of course involved people in the southern California region with more than a dozen attending. Some brought plants to show, give or trade, and some brought slides, photos, and literature to show. Jim served refreshments and after the meeting, took them on a tour of his CP plantings in the glass houses of the research building and in one of the green-houses where he has use of one end for CP. The "West Hollywood contingent" made a quick detour over to Oakhurst Gardens to say hello to Alice Gans. People who have been into CP long enough know well the activities of Mr. Giridlian, the founder of Oakhurst Gardens, in successfully introducing many species into the region and learning how to grow them.

G. A. SERGEANT would like to see more information on the problem of hybridization in Drosera. He has crossed D. capensis with D. spathulata. We recall offhand a well written paper by Wood on the alleged hybrid origin of D. anglica, and another older reference by another author on a natural hybrid of D. filiformis x intermedia that was found in New Jersey. But other than these, we have not run across much. Perhaps someone would like to do a short note review on the subject.

TREVOR KUCHEL would like to know if anyone is going on any field trip for collecting or observing CP's since he would really appreciate either some home movies (Super 8 film) or color slides on these plants growing in their natural state. So, if they would bring a camera and can be bothered with it all, he would appreciate it if they contacted him. He reads with envy about all those who go collecting Nepenthes in North Borneo and visiting bogs where Sarracenias and Darlingtonias grow. He hopes that by this way he can understand what conditions these plants grow under, as he can't even imagine what a bog is! His address is: Box 110, Murray Bridge, South Australia 5253.

STEVE CLEMESHA has been studying the Sarracenia rubra "complex" problem and feels that sub-species status is correct for the jonesii plant of the Carolina mountains. Also, he would place the plant of the Gulf Coast (significantly different from more typical lowland rubras and once erroneously placed in the jonesii taxon) as a subspecies of S. rubra rather than a separate species.

LARRY DeBUHR has some additional comments to append to his Darlingtonia note appearing in this issue: "I've noticed that seeds planted the spring after they are produced will germinate faster than those planted immediately. Also it would appear that vegetative reproduction is the most important method of reproduction at a particular site. Seeds probably do germinate and may add new plants to a population, but the vegetative reproduction is far more productive.

In regard to your question of whether there are any forms in the Darlingtonia genus, there do not appear to be any differences in plants from various areas. From the specimens that I have seen, and from the visits to bogs in the Sierra Nevada and Klamath Mountains and from herbarium sheets, there are no forms that are apparent.

I have finished a paper on the phylogenetic relationships of the Sarraceniaceae. The paper will be published in TAXON, the Journal of International Plant Taxonomists. I have no idea when it will be published, however."

JIM DOTY reports that he is able to control Botrytis mold on Utricularia with applications of Benlate suspension in distilled water. The concentration is 100 mg.(i.e., 50 mg. of active ingredient) per liter. Two applications a week apart seem to do the trick with no harm to Utricularia or Sphagnum.

STEVE KAPA is teaching a two-Saturday course (May 2 and 23) through the Foundation of Revelation in Los Angeles entitled CARE AND FEEDING OF CARNIVOROUS PLANTS. Each student is to receive one Dionaea, three Droseras, a bag of moss, spare leaf cuttings, and lots of good help and information.

The article by Kondo, Kondo and Bogner on Heliophora which was in a recent issue of the Garden Journal (NYBG) and is bibliographically listed in the current literature section of this issue of CPN, contained several errors which may cause confusion. First of all, two mentions were made of the once fact that seed had never been produced in Heliophoras in culture. Readers of CPN have been following the progress of seed production in H. heterodoxa by one of us, with germination and good seedlings. So the plants have been propagated by seed. Secondly, nighttime temperatures in Livermore, California and Statesville, North Carolina do drop to the average recorded levels, but the greenhouses in which the plants are grown average about 65° F. at night rather than the lower outdoor temperatures. The Garden Journal editors have promised space for clarification and photos.

SEED AND PLANT EXCHANGE NEWS FROM BOB ZIEMER: "The CPN Seed and Plant Exchange has grown into a full-fledged international group of CP enthusiasts with 42 participants. In early April we completed a new exchange list containing 232 different species or varieties of CP. The exchange lists will be updated three times a year in the future--January 1, April 1, and September 1. Bob Ziemer will continue to compile the exchange information. Leo Song has volunteered to reproduce and mail the lists to exchange participants. The following persons have volunteered to act as exchange coordinators in their respective countries to reduce the expense of international postage rates and to alleviate the problem of quarantine restrictions on plant importations: Reginaldo Brito - Brazil; Joy de Bruyn - South Africa; Steve Clemesha - Australia; Jim Forrest - New Zealand; Jacques Haldi - Europe; and Kiyomichi Hanabusa - Japan.

Joy de Bruyn informs us that she is planning a trip to the Cape in September in search of the rare African CP including Drosera regia, D. hiliaris, and D. ramentacea. She is currently compiling information on the locations of the South African CP and would appreciate any help CPN readers can give her to make her collecting trip most successful.

The exchange is always interested in new participants with a zeal in cultivating CP. Experience or availability of plants to trade is no requisite for participation. Simply drop a note to Bob Ziemer, 840 Fickle Hill Road, Arcata, CA 95521. Include a list of the plants you are now growing and indicate those, if any, you have available to trade with others. Bob also has a supply of CP seed he will send free of charge upon request. Include about 50¢ for return postage."

DAN SILVER writes (5700 NE 61st Street, Seattle, Washington 98115): "Plant Oddities Club is a division of Armstrong Associates, Inc. Membership for a year into this club costs \$5.00 and entitles a member to a 20% discount for all plants offered by Armstrong. This means that a beginner in carnivorous plants can acquire many species of Drosera, Sarracenia, Pinguicula and Darlingtonia for 20% off the retail price. They also sell other plant oddities (e.g., Mimosa kits), and other things. To your list of sources of CP you can add Edelwiess Gardens, 54 Robbinsville, Allentown Road, Robbinsville, New Jersey 08691. They sell Dionaea, Drosera, Sarracenia, and full-grown Nepenthes khasiana. Their catalog is free."

REGINALDO BRITO writes: "On Sunday, March 17, I went to Petropolis again and with the help of a friend located another D. villosa station, dry, of course, as Petropolis had been as severely hit by this year's drought as Rio de Janeiro had been. But I found another site to eventually go back to. I find the D. villosa plant a very peculiar Drosera for quite a few reasons. First, as you noticed from the clayish soil, it does not grow in moss as do most other species. It is a very moody plant and instead of growing in clusters, it grows very scattered in the field with spaces of sometimes ten inches or more one from the other. How it finds humidity is a puzzle as all the D. villosa I've seen have invariably been found on very coarse, clayish hillsides, so dry even in August and September (winter season) that I assume because of such dryness, the plants can usually display only one or two dewy arms - the newest ones. The other arms seem to

lose their dewy appearance after digesting only one victim. This is in contrast to D. capensis, for instance, which remains dewy indefinitely and catches four or more victims in each trap before waning. In fact, the friend who went with me this last time remarked that it seems incredible they chose to grow on such truly barren hillsides. Mine has taken about a year to adapt to being well taken care of with moss and plenty of moisture and only now seems to be adapting to the comforts of captivity. It is truly a very wild and difficult plant and I don't even know what color its flowers are as I've never seen one in bloom. This drought is said to be the worst in ten years. I'll be happy to see the rains bringing the forests here back to life."

LARRY DEBUHR writes: "I received a grant from the National Science Foundation to travel to southwestern Australia to study adaptive radiation of Drosera. At the same time, I will be able to observe Cephalotus as well as Utricularia and Polypompholyx. I will be leaving in July and returning in November or December of this year."

CARNIVOROUS PLANTS HERE AND THERE...One of the TV networks recently presented The Helstrom Chronicle, a dramatized version of how insects will one day inherit the earth. Featured near the beginning was some excellent cinematography and fair commentary of Darlingtonia californica, Drosera rotundifolia and Dionaea. Watch the first twenty minutes or so during summer reruns...

SHORT NOTES

GROWING DIONAEA AND THE AMERICAN DROSERAS

by the Co-Editors

Drawing by David Kutt

Both genera require just about the same conditions, and any differences between the two, or among species of Drosera, will be noted as we go along.

Soil. The first preference, of course, is native soil, usually acid southeastern coastal plain soil. Notable exceptions are the northern or mountain bog Droseras (D. anglica and D. rotundifolia), these doing better in sphagnum. When using sphagnum, it is better for it to be alive and one of the smaller slower growing species that tends to form a tuft. Coarser species suitable for Sarracenias will overwhelm the little plants. The second soil preference would be an artificial approximation of the coastal plain soils made by mixing one part of dried, milled brown sphagnum or peat (no fertilizer added) with four parts of washed, fine white quartz sand. Wet this mixture thoroughly and let age for two to three weeks to stabilize micro-organism activity. The third choice for all of the plants is the small variety of sphagnum mentioned above. When planting, put the Dionaea bulbs in to the crown and the Droseras to the rosette.

Water. During the active growing season (see Dormancy below) keep the soil constantly moist but generally not sodden. Drosera intermedia is one exception, preferring conditions so wet that it is often found growing in mats across the surface of acid waters. Use water low in chlorine and salts. When watering, it is better not to allow excess water on the plant surfaces, but to water slowly on the soil so it absorbs as you do so. Placing the pot in a tray of water if you have to be away for awhile is all right, but if done for too long a period, salts will tend to concentrate near the surface, and we have found that blue-green algae are encouraged on the soil surface.

Humidity. The higher, the better, ALL OTHER FACTORS BEING EQUAL. In very humid regions of the country during the summer (Great Lakes area, Southeast, Northwest Coastal), the plants could be kept outdoors where they will catch insects as a bonus. In drier areas or if more controlled conditions are preferred, some sort of terrarium setup should be used, assuming you do not have access to a greenhouse. Remember when using a closed terrarium, do not allow it to become overheated by placing in direct sunlight for any protracted period. Sometimes high humidity in combination with too low light level and low temperatures will encourage fungi and algae, so we repeat that all factors should be kept in balance.

Light. About 40-50% sunlight all day is best for maximum coloration, growth and health, provided humidity and moisture can be maintained and overheating prevented. You will, of course, have to adjust the light factor with others depending on what your plants are housed in. Good results are also obtained with any of the new growth intensity fluorescent light setups. Plants grow best when two four-foot lamps (Gro-lux W/S) are on sixteen hours and are fixed six to ten inches above surface of pots.

Temperature. This should be kept ideally at 65-85° F. during the active growing season. If temperatures drop, hold back on the water; if they rise, make sure there is adequate water to prevent wilt and drying and that humidity is kept high. Actually, most of the plants (except the bog Droseras listed before) can take temperatures up to 100° F. as they do in nature for brief periods as long as soil moisture and humidity is maintained. But plants in culture need more pampering.

Dormancy. Neglect of this factor is probably the most frequent reason for plant loss by the new grower. Both genera require a period of dormancy which is conveniently coincident with winter in the United States. Fluorescent light growers must make artificial compensations. To try to "force" the plants at this stage in their annual cycle is to invite disappointment and rot. During dormancy, the plants require cool temperatures, reduced light with shortened photoperiod, and reduced watering so the soil is just damp. As long as the roots do not freeze, both genera can take temperatures down below freezing (to varying degrees), as evidenced by the many Droseras native to northern reaches and the survival and multiplication of Dionaea transplants in New Jersey and Pennsylvania. If your plants are potted or tubbed, be cautious of exposing them to too low a temperature below freezing since containerized plants above ground are more likely to suffer severe root freeze. As a maximum temperature to achieve full dormancy, we would suggest 40° F. generally; as a general minimum to prevent freeze damage (and this also depends on mass of container, two-inch pot vs. two-foot tub), 25° F. In very cold regions of the country (mountains, Kentucky north), wintering plants can be stored in a cellar or protected area in their pots, an area that does not get too far below 30° F. but that also does not warm too much.

During dormancy, most leaves of Dionaea will blacken and die back except (in warmer regions) for the central rosette of widened winter leaves with small traps. This is normal and typical trap formation will resume in the spring. In the outdoor cooler regions, all leaves may die back for the winter. If you wish to grow Dionaea and American Drosera during winter, we suggest that you use plants that were previously induced into dormancy by refrigeration for a period of six to eight weeks. But in breaking this dormancy, you must use artificial light to supply the long photoperiod required for normal growth.

An interesting feature of Droseras is that all except D. capillaris and D. leucantha (brevifolia) form compact winter buds (hibernacula) at ground level. Thus, during dormancy, the two species above will have inactive winter rosettes while the others appear to have died, but close inspection will disclose the winter bud. Drosera filiformis filiformis (northern form) has moist, brown hairs covering the bud and they look for all the world as if they are blackening and rotting. But careful probing among the hairs will disclose bright green leaf buds. Often, as winter bud formation occurs the plants may divide and multiple buds are formed and you are rewarded with a cluster of plants in the spring.

The primary dormancy breaker of these genera seems to be lengthening photoperiod with concomitant rising temperatures. So you can pretty well follow the calendar and signs of spring in deciding when to place your plants back into active growth conditions. Fluorescent light growers should increase photoperiod first, then slowly increase temperatures, then give more water.



1. D. rotundifolia
2. D. anglica
3. D. filiformis fil.

4. D. intermedia
5. D. capillaris
6. D. linearis

7. D. filiformis tracyi
8. D. leucantha(brevifolia)

Anthers mature before stigmata (protandry) in the same flower and frequently shed all their pollen, unless the air is quite still. Therefore, cross fertilization gives more certain results. One can pick out individual anther heads if he has excellent eyes and superb patience, but the easiest method is to simply press two flowers of two different plants face-to-face with a slight circular motion to effect cross contact of anthers and stigmata. By the way, during flowering Dionaea becomes a little "ragged"-looking with poor trap and leaf formation. This is normal and good traps will grow after flowering is completed, or you may simply clip the flower scape if you are not interested in the flower or seed.

Many Droseras are self-pollinable and in fact do so as they close at the end of their one day of life if a pollinator has not done the job earlier. But to be safe, it is best to use the method described for Dionaea.

Seed matures for both genera in six to eight weeks and is about the size and color as poppy seed in Dionaea, and almost dustlike in Droseras. Since this is summer maturing seed as opposed to autumn maturing seed, a cold pregermination period is not required. Seed is best sown immediately (unless stored under refrigeration) since it will germinate best at this point and will rapidly lose viability when stored under ordinary conditions.

Leaf cuttings. All of the Droseras can with ease, and Dionaea with some difficulty, be propagated by this means. Select fully emerged but preferably fresh spring leaves and clip them off at the petiole base. Dionaea leaves should be peeled back down to the bulb. Press the leaves onto the surface of moist live sphagnum so that total contact is made (check daily, buckling tends to occur the first few days), cover the container with plastic or glass and place in warm shade. In a few weeks, you will note young plant buds, usually many to a leaf. Let these grow until a good root system is under way and the mother leaf is nearly decomposed, then transplant.

COMMENTARY

by E. T. Wherry

(Dr. Wherry has sent us several interesting comments which we have combined into a short note--Ed.)

Nerve-like signals in plants. In the November, 1973, issue of Bioscience one of the "Biology Briefs" on page 672 is thus headed: "Stephen E. Williams, plant physiologist and instructor in biology at the N.Y. State College of Agriculture and Life Science, Cornell, reports finding that the tentacle-tip of a sundew contains cells which transmit nerve-like signals from one point to another. However, the signal in the sundew proved to travel as much as 10,000 times slower than in animal systems."

The value of the prey to carnivorous plants. In a book on Rare Wild Flowers of North America by Leonard Wiley a common misconception is written up in attractive fashion. Under Darlingtonia californica we read: "A popular fallacy is that these plants depend completely upon the insects they capture for their sustenance. Insects are no more important to Darlingtonia than orange marmalade is to you. Like all other chlorophyll-bearing plants, it gets most of its nourishment from the soil and air." And similar remarks are made under Dionaea muscipula.

The chlorophyll of higher green plants actually enables them to assimilate only carbon (dioxide) from the air. All other elements must be absorbed through the roots from the soil. Carnivorous plants grow in soil so sterile that the essential elements nitrogen, phosphorus and potassium, to say nothing of trace elements, are inadequately available to their roots. They accordingly obtain these elements from their prey.

Two bladderwort surprises. The recent note on a range extension of Pigmy Bladderwort (CPN II, p. 59), Utricularia olivacea, brought back memories. In September, 1959, Mrs. Ruth McVaugh Allen, a local botanical artist, sent me for identification sketches of a tiny bladderwort which had been discovered floating just under the surface of the "Goose Pond" southwest of Egg Harbor, New Jersey, by Frank and Robert Hirst, keen amateur botanists of Pleasantville. Unexpectedly it proved to correspond to Utricularia olivacea which was thus far known in the U.S. only from Sanford, Florida. Mrs. Allen wrote this up for Bartonia, and it was published in No. 29, dated December 16, 1959. Her illustrations seem to have been the first detailed ones made of this plant; they are reproduced on the cover of this CPN. Intermediate stations were subsequently discovered in North Carolina, but extreme range disjunction seems still represented. Carnivorous plant enthusiasts may well be on the lookout for it in intervening Coastal plain ponds.

The Inverted Bladderwort, Utricularia resupinata, is so rare in New Jersey that new stations are considered worth recording. Early one spring I was exploring the margins of the Big Cypress Swamp on southern Florida, and while looking down to make sure I was not stepping on a water moccasin, I noticed a profusion of tiny lavender flowers. They turned out to belong to this species--here so common that scores were crushed by every footstep.

An unacceptable Sarracenia lectotype. Linnaeus named the genus Sarracenia after a Quebec physician, Dr. Michel Sarrasin de l'Etang, who sent him specimens which regrettably failed to get preserved. Earlier diagnoses of Sarracenia purpurea L. by both northern and southern workers were cited. Rafinesque realized that the species is not geographically uniform; changing the genus name to Sarazina, he designated the northern extreme by one word quoted from Linnaeus' diagnosis, gibbosa, and the southern extreme by the descriptive word venosa.

The differences between the two seeming insufficient for species separation, the writer reduced them to subspecies, as ssp. gibbosa (Raf.) Wh. for the northern and ssp. venosa (Raf.) Wh. for the southern element. Unwilling to follow the International Code, Fernald changed these to varieties; then since it had become customary to repeat a species epithet for an infraspecific taxon including the type, or omit it entirely, the two became respectively S. purpurea (typical) and S. purpurea var. venosa (Raf.) Fern. in Gray's Manual, Ed. 8. Without explanation and in defiance of the fundamental principle of priority, McDaniels (Bull. Tall Timbers Res. Sta. No. 9, 1971) "selected" as lectotype for Linnaeus' species the illustration of the southern extreme in Catesby's volume on the plants of the Carolinas. The acceptance of this proposal is herewith disrecommended.

On Darlingtonia vs. Chrysamphora. In 1851, when John Torrey proposed to name the western pitcherplant in honor of Dr. William Darlington, he overlooked the fact that there was already in the literature a "Darlingtonia" applied to a wholly different plant, rendering his proposal invalid under the International Code of Nomenclature. The wholly new name Chrysamphora was accordingly proposed by Greene in 1891. From that date until 1954, this was the valid name for the plant, and should have been used by all writers. Then a committee of taxonomists was asked to study the matter, in which by the narrow vote of 6 to 5, the name Darlingtonia was conserved as reported in the journal TAXON 3, No. 4, May, 1954. By this slim margin, then, validity of Darlingtonia has now been established, and it should be used by all writers, unless and until the problem gets reconsidered.

SOME INTERESTING VARIATIONS IN DIONAEA MUSCIPULA

by Steve Clemesha

As Dionaea is a monotypic genus with a rather small natural distribution, it is fairly logical to think of the plant as being a very uniform one and as I have read nothing to the contrary, I believed this was so until I received plants from friends which clearly are different. Naturally, I was skeptical at first and encouraged to be so by my friends in the U.S.A., but after having the plants for more than one year and propagating new ones from small pieces, it is now clear that all except the last-to-be-mentioned variation is distinct and remains true to type. This could also prove to be true of the last-to-be-mentioned plant, but mine are not yet advanced enough for me to be sure.

In the case of all the plants mentioned below, except those I received from the U.S.A., I do not know if they were originally wild collected or have been selected in cultivation. Perhaps someone else can answer this question. I am fortunate to know where my plants came from even though all reached me indirectly.

The main form I have received from the U.S.A. produces a rosette of traps with a short petiole in early spring and late summer. These traps are prostrate. In the main part of the growing season, the traps are formed on petioles more than twice as long which are much more slender and erect. All my plants of direct U.S. origin have been like this and all with a fairly uniform degree of pigmentation (i.e., light red on the inside trap) except for one.

This plant is still small but clearly differs from all others in being much paler. Most of its traps lack any pigmentation and none is present on the petioles. The plant has an almost yellow-green appearance reminding one of Sarracenia purpurea forma heterophylla. However, at certain times of year, especially when we get a lot of cloudy weather, the plant's new traps color inside. This color does not persist long and soon fades out. It appeared among a batch of normal seedlings raised from wild collected seed.

About eighteen months ago, I received some plants of a Japanese cultivar, "Dionaea muscipula forma erecta." These plants appear the same as those I have received from the U.S.A., except they are deeper colored. Next, I received plants also of Japanese origin of "D. muscipula forma muscipula", i.e., the typical form. This is a very different plant from those I had received from the U.S.A. All traps are on a short petiole and the traps which are crowded close together and the petiole lie flat on the ground. It is a neat colorful form.

The next form is not a form at all. This is "D. muscipula forma filiformis" which has the basic habit of the "erecta" type but is a rather pale form and its traps are on a very long slender petiole and give the appearance of a plant growing in heavy shade. I do not know how tall it becomes as my original was accidentally pulled up and lost presumably by a bird.

Fortunately, I propagated two tiny plants from it before this happened and these are still small but are showing the same strange habit.

The remaining plant is "D. muscipula forma linearis." It also has the basic "erecta" habit and just how it differs, I cannot tell from my tiny plants. So far its petioles seem more linear and less tapered in shape and the teeth on the trap are shorter and finer; but as the plants are only small, these characteristics could disappear, so here it is clearly a case of wait and see.

WHY A FLYTRAP IS NOT A BEAR TRAP

by Stephen E. Williams

The obvious similarity in form between the structure of a Venus' flytrap and a bear trap has on occasion led people to carry the analogy too far and draw a number of false conclusions about the mechanism of movement and insect capture in Dionaea. A review of this subject, which is apparently more confusing than first meets the eye, may help to avoid further false analogies.

A look at both a flytrap and a bear trap--of the type often depicted in cartoons--reveals that:

1. Both have two lobes which close together.
2. Both have teeth on the edges of the lobes.
3. Both have a trigger (or triggers) inside the lobes which spring them.
4. Both have bait* which attracts the victim to the trap.

These similarities easily lead to the formation of further, but false analogies between the bear trap and the flytrap. For instance it would be tempting to draw the analogy that the "teeth" or projections along the margin of the flytrap lobe might bite into the prey, or to conclude that the midrib of the flytrap acts as a hinge. Indeed the second of these analogies has been seriously made in various scientific papers. It does not require scientific training, however, to easily confirm the falsity of both of these analogies.

Observation of the flytrap reveals that it imprisons its prey between the lobes and that the cavity formed serves as a gut during the digestive stages. The teeth on the lobes serve to bar the escape of a sufficiently large insect and not to grasp it or stab it to death. By contrast the bear trap grasps its prey between its jaws and holds it until the trapper returns. In this case it is the trapper who provides the digestive apparatus. Charles Darwin placed a great deal of emphasis on the fact that the teeth on the lobes of the flytrap allowed the little ones to get away thus saving the leaf the energy consuming process of digesting an insect which would only yield a small return.

That the midrib of a flytrap is not a hinge is also easily observed. Most fully expanded leaves have lobes which have a concave outer surface. During closure it may be seen that the lobe reverses its form and its outer surface becomes convex. The majority of the movement occurs because the lobes mechanically flip inward. This mechanical flipping of the lobe amplifies a biological response in the lobe epidermis that is more sophisticated and is not well understood. The movement occurs in the lobes of the trap, not in the midrib and thus the midrib is not a hinge. On the other hand the bear trap consists of a spring loaded set of jaws connected by a hinge at each end and the closure of the rigid jaws consists of the rotation of the jaws on the axis of the hinges. There is no flipping (or flexing of the jaws) involved.

A consideration of the differences between flytraps and bear traps offers an explanation of why there are no reports of Venus' flytraps capturing North Carolina's bears but it does not really tell us how a Venus' flytrap closes. There are a number of experiments which have been performed which give us some indication of how this movement occurs. There is one hypothesis which I believe is the most plausible. Some of these experiments were done using Dionaea and others using Aldrovanda, which presumably has a very similar mechanism of movement.

*The outermost sessile glands of the Dionaea leaf have been called alluring glands. Firm evidence that they do attract insects has yet to be established but it does not seem unlikely that there is some sort of attracting agent.

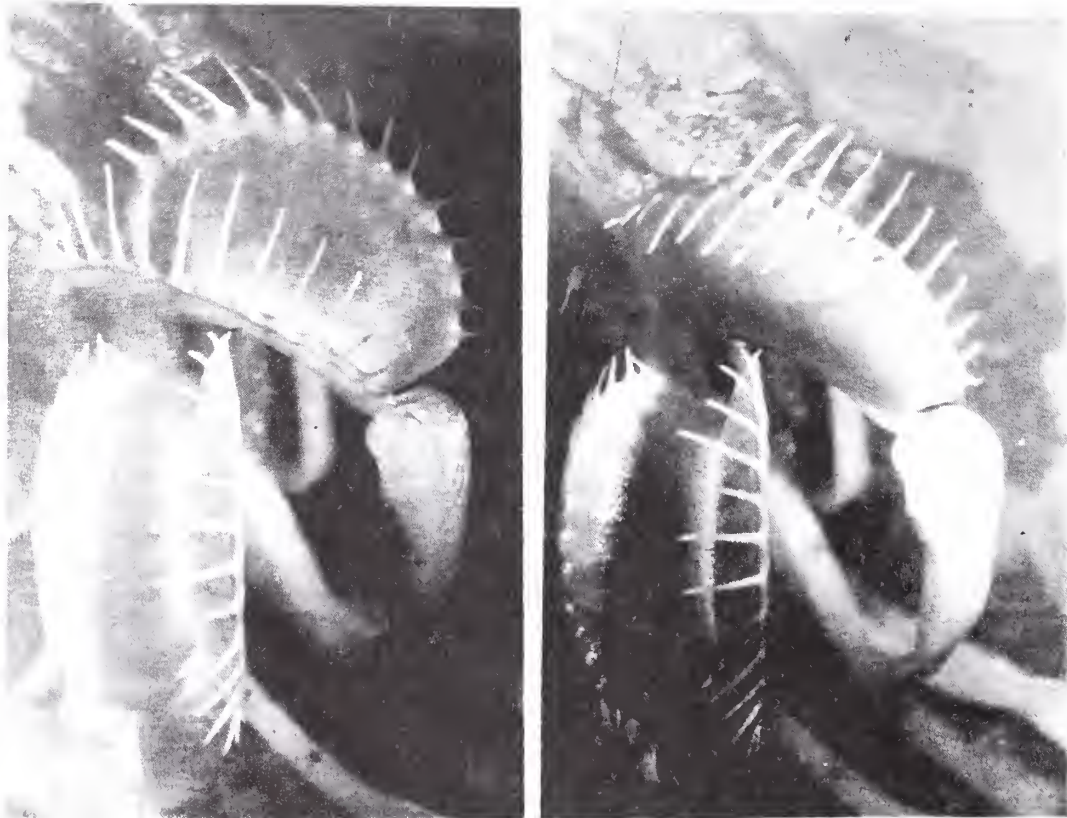
Work with Aldrovanda done by Joji Asheda in 1934* indicates that all of the movement in the leaves of that plant occurs in a "motile zone" about one-third of the way up the lobe and that the outer epidermis is under stress when the trap is fully open. After the movement the outer epidermis does not appear to be under stress. Asheda stated the very attractive hypothesis that the cells of the inner epidermis and the outer epidermis are both turgid when the trap is in the open position and that triggering the trap causes the cells of the inner epidermis to lose water and become more flaccid (as the plant does when it wilts). Asheda believed that the outer epidermis would then expand since it was no longer

pushing against the inner epidermis. This would cause the slight increase in length of the outer surface of the lobe needed to flip it inward. Data gathered earlier by William Brown in 1916** indicates that the inner surface of Dionaea does not shrink significantly during the closure but that parts of the outer surface of the lobe expand as much as 8% in length. Although Brown interpreted his data in another way it is consistent with Asheda's ideas about how the trap moves. Although Asheda's papers are well reviewed in Lloyd's monograph, they are in English and it is worth taking the time to read the original work.

It would appear that the flytrap closes by a loss of water from cells on its inner surface which allows the cells on its outer surface to expand to their full size resulting in a slight curvature of the lobe which is able to flip it from its outward curving position to an inward curving position. The result of this movement is the creation of a prison with a barred opening that prevents the escape of the creature ensnared within. This trapping mechanism bears little resemblance to a bear trap if all the particulars are considered.

* J. Asheda: Mem. Coll. Sci., Kyoto Imp. Univ., Ser. B. 2, 141-244 (1934)

** W. Brown: Amer. J. Bot. 3 68-90 (1916)



Leaves of Dionaea x 4. When the trap is open the outer surface of its lobes are concave. When the trap closes the outer surface of its lobes are convex. The movement occurs in the lobes not in the midrib. Photographs were taken with equipment which was kindly provided by Dr. Natalie W. Uhl of the L. H. Baily Hortorium, Cornell University.

THE DISTRIBUTION OF DARLINGTONIA CALIFORNICA

by Larry DeBuhr

Mr. Ziemer in Volume II, No. 2 of CPN wrote a very interesting note and discussed the local ecological conditions at several Darlingtonia bogs in Del Norte Co., California. I would like, as a follow-up to Mr. Ziemer's note, to discuss the total distribution of Darlingtonia. As background information for a study of various aspects of the biology of Darlingtonia, I felt it was important to familiarize myself with the total distribution of the species. I did this by studying labels on specimens of Darlingtonia that have been deposited in various herbaria, particularly those in California and Oregon. Some of the older collections lacked detailed information, and the exact location was not indicated.

Space restrictions do not allow me to list the locations of the Darlingtonia bogs, but I will supply this information to anyone who wants the details. Figure 1 is a map of the known distribution of Darlingtonia californica. The dots do not, in every case, represent a single station, but may represent several close locations as in Plumas and Nevada Counties, the two dots farthest south in California.

Darlingtonia is a long-lived, perennial plant that vegetatively reproduces by the production of a single, small plant at the end of each of a number of stolons. The abundance and the density of Darlingtonia in a bog attests to the importance of vegetative reproduction in the maintenance of the species. The long-lived nature of the plant and the high rate of vegetative reproduction are indications of the stability of the individual populations, and the stability of a population is an advantage when exacting ecological and geological conditions are required for growth. A Darlingtonia bog can be hundreds, even thousands, of years old, and will continue to exist until the conditions for growth are altered, either by natural means (long-term drought, volcanic or other geological activities, etc.) or by man-caused destruction. Certainly, Darlingtonia does not grow in every area that could sustain a bog. But, with time, a seed blown by the wind, carried by an animal, or washed downstream will land in a suitable habitat and a new bog will develop. Over long periods of time, thousands of years, the locations of Darlingtonia bogs will shift, but viewed in a narrow time period (recorded botanical history) the locations of the bogs remain unchanged.

In California, Darlingtonia occurs in the Sierra Nevada in Plumas and Nevada Counties. As yet, Darlingtonia has not been found in Sierra County, between Plumas and Nevada Counties. Farther northwest in the Klamath Mountains many populations occur in southwest Siskiyou, northwest Shasta, and northeast Trinity Counties and in northwest California in Del Norte and Siskiyou Counties. In Oregon there are locations in the Klamath Mountains in Josephine and Curry Counties, along the coast in Coos, Lane, and Lincoln, and Tillamook Counties, and inland in Yamhill, Linn, and Lincoln Counties. Specimens collected from three localities, the first from the west side of MacKenzie Pass in Lane County, the second from Linn County near Sutter Lake, and the third from a slough near McMinnville in Yamhill County, are of interest since they indicate Darlingtonia might be found quite a distance inland in Oregon. Only one specimen has been collected at each of these locations, and I have not been able to visit any of these locations to check the accuracy of the records. Verifications of the existence of Darlingtonia at these three localities is definitely needed.

The locations in the Klamath Mountains are concentrated in two areas, one in Siskiyou, Shasta, and Trinity Counties and the other in Del Norte and Siskiyou Counties and in Josephine and Curry Counties in Oregon. These two areas are geologically rich in ultramafic (ultrabasic) rocks (see Irwin, W.P., 1966, Geology of the Klamath Mountains Province,

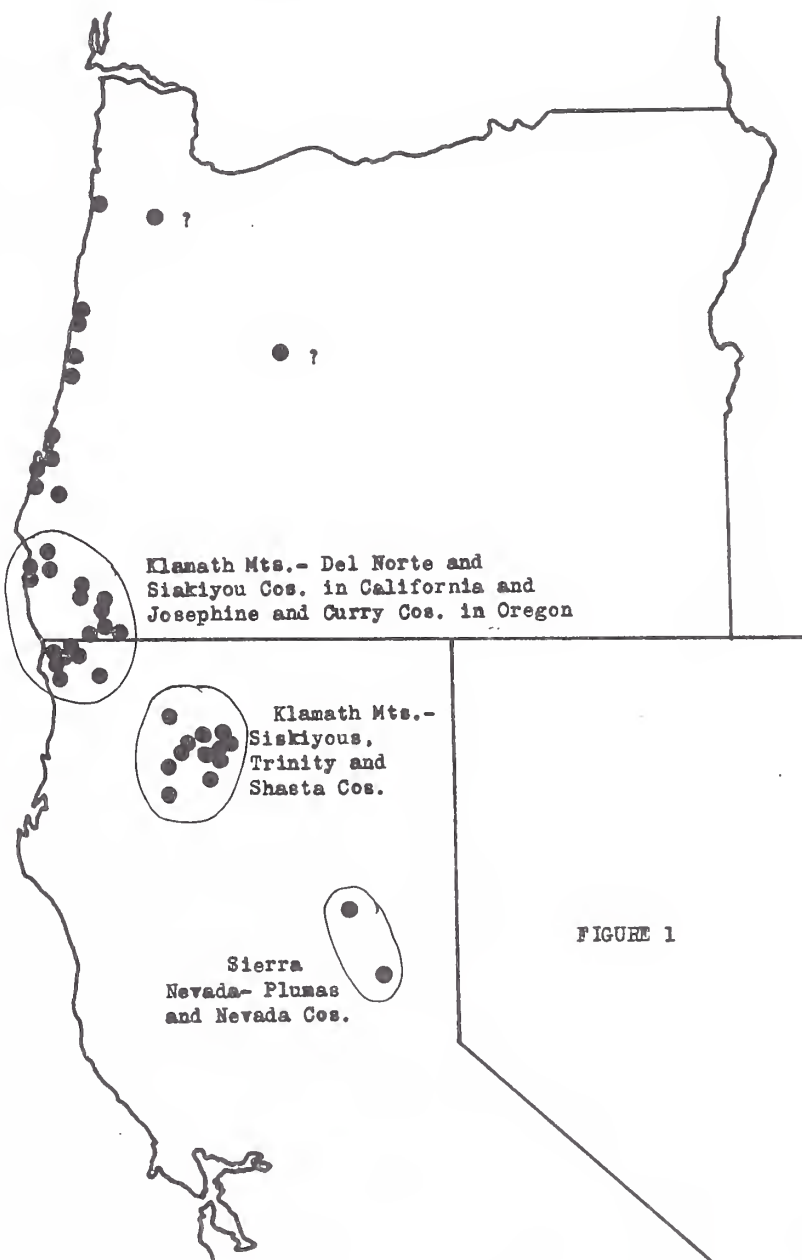


FIGURE 1

pages 19-38 in Geology of Northern California, ed. by E. H. Bailey, California Division of Mines and Geology Bulletin 190, San Francisco) which contain serpentine. In the Sierra Nevada, the locations in Plumas and Nevada Counties are associated with a major serpentine-belt fault bordering on a layer of greenstone. (See McMath, V.E., Geology of the Taylorsville Area, Northern Sierra Nevada, pages 173-183 in Geology of Northern California.) Greenstone consists of altered basic igneous rocks which contain serpentine minerals. I have not seen a geological map of coastal Oregon and do not know if any serpentine occurs in that area. I would not be surprised if the mineral composition of the soil along coastal Oregon is very similar to the composition of serpentine soils.

Whittaker (The vegetation response to serpentine soils. Ecology 35:275-288, 1954) listed Darlingtonia as a familiar species in bogs and marshes on serpentine soil. Walker (Factors effecting plant growth on serpentine soils. Ecology 35:259-266, 1954) and Kruckeberg (Plant species in relation to serpentine soil. Ecology 35: 267-274, 1954) concluded that plants growing well on a serpentine area, above all else, must tolerate low levels of calcium in the soil. In addition, high magnesium, nickel, and chromium, low available molybdenum and major nutrients (nitrogen and phosphorus), and unfavorable physical aspects of the shallow soil must be tolerated, depending on the particular location of the area. An important factor involved in the strong correlation between the distribution of Darlingtonia and the occurrence of serpentine is the low soil fertility that is characteristic of serpentine. Darlingtonia can tolerate the conditions that accompany serpentine soils.

There are other features, in addition to the geological correlations, that regulate the distribution of Darlingtonia. The main factor is the availability of water. The bogs are all located in areas that have a continuous or near continuous supply of running water from upslope seepage. Few bogs that I have visited had standing water. An often overlooked geological feature is the local rock formations which must allow seepage to occur. Related to the availability of water are correlations in rainfall. The mean annual precipitation in the Sierra Nevada and the Klamath Mountains in the area where Darlingtonia grows is more than 40 inches and commonly exceeds 60 inches (Oakeshott, G.B., 1971, California's Changing Landscape, McGraw-Hill, New York) and in coastal Oregon approaches and exceeds 80 inches. Temperature does not appear to be a critical factor in the distribution of the species. Variations in temperature occur across the range of Darlingtonia. The plants grow well both in areas that have subfreezing temperatures as well as along the much milder coast. Certainly excessive cold or heat would be detrimental to the plants.

In California two large gaps occur in the distribution of this species. In the Klamath Mountains the break between Del Norte-Siskiyou Counties and Shasta-Siskiyou-Trinity Counties can be explained in several ways. Possibly a lack of suitable habitat is involved. However, there are areas that contain ultramafic rocks and the whole region receives sufficient rainfall. It is also possible that this area has not been sufficiently collected and that populations of Darlingtonia remain to be discovered. Of more significance is the break between the Klamath Mountains and Plumas County. Geologically the area is mainly volcanic in origin and relatively recent. (See MacDonald, G.A., 1966, Geology of the Cascade Range and Modoc Plateau, pages 65-96 in Geology of Northern California.) The rocks do not contain serpentine, and much of the area receives less than 20 inches of rain on a yearly average. Lack of available habitat is presumably the reason for this gap.

In conclusion, I would like to mention briefly a few points concerning the conservation of Darlingtonia. Several factors favor the opinion that the Darlingtonia bogs are in no immediate or foreseeable danger. Darlingtonia grows on serpentine soils that have low soil fertility, and subsequently no value as farm land. The bogs are often associated with rocky hillsides that make farming and grazing unlikely. Trees growing on serpentine are often stunted and are not sought after as timber. The absence of valuable mineral ores in serpentines make the possibility of mining remote. There are two areas of concern. Large-scale commercial harvesting of this species could decimate a population of Darlingtonia. However, without knowing where or how the plants are gathered, it is difficult to evaluate the total effect of commercial collecting. Damage to a bog by visitors is also a possibility. Excessive trampling in bogs results in crushed plants, especially the smaller Droseras and Pinguiculas, as well as in damage to the bog habitat. Care must be taken when visiting any of our natural bog areas to see that overuse does not result.

FIELD OBSERVATIONS OF DROSERA ARCTURI AND D. SPATHULATA IN NEW ZEALAND

by Peter Muller

One Saturday morning right after I had just received my license to drive, my father and I set out for Lewis Pass on the South Island. It took a while to get there but when we did arrive, we tried to follow instructions given to us by the director of the Botanic Gardens and we finally had to resort to asking where we might find the local sphagnum bog. Unfortunately, this fellow was not familiar with the name of the moss but he did happen to mention a small plant which he and his friends called "the fly-catching plant." It became immediately apparent to me that the plant he was describing was Drosera. He

directed us to a place where the plants were growing. We passed it on the way up to the summit and had to go back about two miles where we parked our cars and climbed a small embankment up onto a natural shelf in the side of the mountain. I would imagine that in the past, this shelf would have been a collecting point for the run-off from melting snow. But in time, it had begun to fill with moss and in some places the water covered the moss so it could not be seen.

The Drosera arcturi plants completely covered the area and it was impossible to walk through them without stepping on them. Since this was December, the plants were at the height of their growing season and many hadn't flowered yet. They grew to a height of about 6 inches in some cases but most grew only to about 3-4 inches. The flowers were borne singly on one stem, and its height was not much higher than the surrounding leaves of the plant. The overall plant color was rusty brown.

As we sat down to have some lunch, I noticed that another Drosera, called spathulata, was growing in the same sort of soil in community groups but was not nearly as abundant. It seems that the surrounding cover (which is very sparse but enough to bury these small plants) is very steadily smothering them. These plants were also ready to flower and each one bore one or two flower scapes crowned by a small group of buds. Overall color was red for the leaves, flowers and buds.

All the plants I found were growing in direct sunlight and would get sun for most of the day. This would explain the red pigment in the leaves. No plants were found growing in the shade, and none were found to be growing in "perpetual" puddles or in excessive dryness. Also, during the winter, the plants would be covered with snow. I would grow these plants at temperatures under 70° F. since my experience with growing them is that any higher temperatures lead to disaster. Therefore, glasshouse conditions are not necessary, but the humidity must be high.

FURTHER HINTS ON GROWING ALDROVANDA

by J.A. Mazrimas

I would like to add further details to the excellent instructions given by Messrs. Ohtaki and Katagiri on growing Aldrovanda in culture. The main thing to remember is that these plants are sensitive to acidity, require a high nutrient diet in order to grow and branch often, and finally require fairly strong light to grow.

The first thing that I did when I received my plants was to make a suitable medium for them to grow in. This involved making a hay infusion or culture of microorganisms which include bacteria, Paramecia, Euglena and others. I found some dried grass, hay or straw and chopped it into four-inch pieces which I stuffed into a tall jar (a one quart fruit jar or large mayonnaise jar) and filled to the brim with boiling water. This is set aside in a warm room for about a week in which time the water becomes yellowish-brown and slightly cloudy. I also made a similar culture from stalks and leaves of dried cattails (Typha) which you find growing along most shallow ponds and ditches wherever water is present all year. Other water plants can be used too.

Next, I visited a tropical fish store and purchased a bottle of Brom thymol blue, which is a pH indicator dye. It is not necessary to buy the entire measuring kit since I'll tell you how to use it here. Also, it is a good idea to purchase some sodium biphosphate to regulate the acidity of the culture.

Then, I arranged a plastic shoebox, which you can purchase at most large department stores, in the following way: first, I placed a layer of washed sand followed on top by several handfuls of straw and cattail leaves from the culture. Then I poured about an equal mixture of the culture solutions until full. Now it is ready for the Aldrovanda. Place the box in a bright and warm area, about 50% sunlight for one-half day with temperature fluctuating between 90° F. in the day to 65° F. at night. It seems that the shallow depth (about four inches) and wide surface area provided sufficient air exchange to occur without the need for a bubbler. Next, I was ready to check the water's acidity.

I scooped a small sample of the culture solution into a vial or test tube and added 2-3 drops of Brom thymol blue solution. If the water turned yellow, then it would indicate the water was too acid and if blue, it would be too alkaline. When the solution becomes green, then acidity is just right which is simple to remember as you view the green plants floating in the water. As my solution aged, it had a tendency to turn alkaline and the water color darkened with increasing growth of undesirable algae. Fresh hay infusions are usually acid when ripe and so adding the correct amount will adjust the pH back to the "green" region. Also, a pinch or two of sodium biphosphate will also bring the pH back to the normal range.

One of the best ways to maintain the optimum pH of 6.2 is to prepare a peat moss infusion by pouring water over it and allowing to set overnight. Add enough of the resulting liquid

to the culture to achieve a pH of 6.2. Add more distilled or rain water to the moss and keep on hand as stock acid water.

You can feed Aldrovanda additional nutrients by purchasing a culture of microworms (which you grow on a cornmeal mush) from a large tropical fish store or mail order houses that advertise in hobby magazines. Using a fine tip dropper, one can direct a thick suspension of these tiny worms into an Aldrovanda trap and watch it rapidly close on the white wriggling mass. If you find some pond water with copopods swimming in it, these seem to be ideal for the trap size of this species. By so doing, I noticed that plants began to branch from the terminal axils, a sign that all is well and you're on the way towards propagating the plants from these branches.

CULTURE OF ALDROVANDA

by Jacques Haldi

Aldrovanda is a rootless plant that floats on the surface of clear acid water. It requires a high light intensity, warm (21-26° C.) and acid water. I think that slightly briny water is a good thing. This you can make by using a little kitchen salt (NaCl or Na⁺, Cl⁻). It is better if there are some small crustaceans in the water because if they are missing, the plant does not grow so well and the leaves stay small in size. One can observe the capture of these crustaceans by placing the plant in a clear glass. It is very difficult to observe this phenomenon in an aquarium. For propagation of the species, cuttings are made in summer so that they will be strong enough by fall to produce winter buds. This plant should be started into dormancy in September. To prepare the plant for this process, the plants must be in 8° C. water with very good luminosity. I like to use mud taken from a swamp that is algae-free and place this mud in the bottom of the container. The minerals from this mud seem to help the plant grow stronger and help the plant acquire extra buds. The mud is also useful because when the winter buds form, they will sink into it during the long winter rest. In the culture of Aldrovanda, algae is the biggest enemy. It is best not to place the container directly in the sunlight but instead use bright diffuse light.

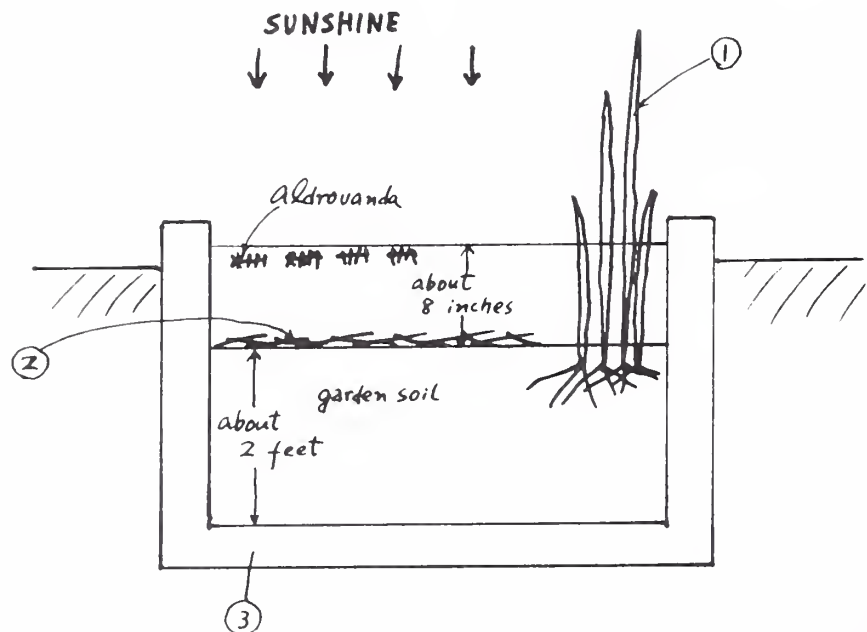
GROWING ALDROVANDA

by Kiyomichi Hanabusa

(1) Iris, or other water plants such as Zizania latifolia, Typha latifolia, Phragmites communis, may be useful. Their roots are believed to produce acidic substance which lowered the pH of water. I prefer wild Iris.

(2) Immerse dead rice grass (stem) enough to change the color of water "beer-like yellow." We often use the rope made of dead rice stem. This rope is customarily used in Japan (especially in farmhouse).

(3) Trough made of concrete (cement). If you use new concrete container, first fill water and immerse much hay or rice stem and keep them for couple of weeks to neutralize alkaline extract.



Necessary conditions: (1) Sunshine (2) Garden soil at the bottom of container
(3) Water plant (4) Dead rice grass (stem)

Bad sign: Algae growing. If a "bloom", water should be renewed and more rice stem added.

FOLIAR FEEDING

by J.A. Mazrimas

Several years ago I decided to experiment and feed some of my collection of carnivorous plants with weak dilutions of organic and inorganic fertilizers to see what effect such treatment had on growth. I am convinced now that these periodic applications not only produce more vigorous growth but also seem to promote numerous flowers and more seed. The method that I use is the following:

I use several types of inorganic fertilizer (10-5-5 or 11-8-4) or fish emulsions (5-1-1) as an organic type. I make a solution about 1/5 to 1/10 the recommended concentration used for fertilizing ordinary house plants as stated on the label directions. This solution is then poured into a plastic sprayer that operates by pressing a trigger and the output can be regulated by turning the nozzle between a coarse spray and fine mist. It is best to use a fine mist for Droseras and Pinguiculas with an amount which just lightly moistens the glandular hairs or surface of the leaf. Within a few minutes, one begins to notice that several of the tentacles start to move inward and in the case of Drosera capensis, several leaves begin to curl up and form a roll. The edges of many Pinguicula leaves roll into a trough-like formation in an attempt to form a pocket for the various enzymes to operate. I like to experiment with different concentrations and volumes to find the combination that gives the best effect. I should add here that application of fertilizers should only be carried out on healthy, vigorous growing plants during the growing season. Usually, a fresh solution can be made and applied at a 6-8 week interval.

Other plants such as Drosophyllum and Byblis show no movement of their glandular hairs as in Drosera; but nevertheless, the effects of these applications are evident in the spurt of new growth or production of flowers. For Nepenthes I also use the same diluted fertilizer solution but in this one case, it is more effective to pour it directly into the pot so that the roots can take up the elements needed for rapid and vigorous growth. Pitcher formation is not inhibited if sufficient light of the proper duration is given along with this treatment.

If you have the time and patience, a small amount of this diluted fertilizer solution can be squirted from the same sprayer (by regulating the nozzle) into the opening of the pitchers of Sarracenia, Cephalotus, Heliamphora and Nepenthes. Alternatively, a fine mist that is just light enough to moisten the outside pitcher walls without dripping is also effective. I frequently use this method with S. psittacina because of the difficulty of squirting fluid into the tiny openings.

Finally, one generally must be careful not to overspray the plants so that excess fertilizer drips into the root system since this is detrimental to the plant. It is best to make a lighter application since many species are especially sensitive to minute amounts of nitrogen which they efficiently absorb into their tissues.

SPECIAL NOTICES

Now that we have the photo reproduction business settled, we would welcome any photos readers would like to send in for consideration for CPN. They can be either color or black and white prints (all will, of course, be in CPN in black and white anyway), or you can send slides. Send along a little description. Since we may keep some in the files for use several issues ahead, we would suggest you send prints or slide copies you do not want returned. You will be given full credit for the photos and they will not show up anywhere else. The best reproduction will be obtained if the main subject fills most of the picture and stands out clearly from the background, and of course contrast must be excellent and the photos wire sharp to begin with.

At last we can announce a new book in English dealing with CP. James Pietropaolo has just completed a book with his wife and edited by Dr. Lorin I. Nevling, Jr., former curator and supervisor of the Harvard Herbaria. The book is called THE WORLD OF CARNIVOROUS PLANTS and covers Sarracenia, Nepenthes, Cephalotus, Dionaea, Drosera, Byblis, Drosophyllum, Darlingtonia, Pinguicula and Utricularia. There are over 60 photos, and instructions on growing are stressed. The book is available directly from James at 4646 Emerson Road, Canandaigua, NY 14424. The cost is \$5.95 (\$6.30 postpaid surface U.S.). (NOTE: As of CPN press deadline, May 1, the editors have not yet received copies of the book that they ordered. We presume there has been a publication delay, and we suggest inquiring of the author before ordering.)

With this issue, we begin distribution of the computer printed worldwide CP list, inserted into the mailing as a supplement. A few pages at a time, as mailing weight limits allow, will be sent out over several issues until mailing is complete and you will eventually have

the entire list. Hopefully, mailing will be completed by the end of this volume.

CHANGE OF ADDRESS - Several subscribers have moved and not sent in their new addresses or in some cases bothered to notify the post office. Then we get bitter letters about issues of CPN "lost" in the mail. Please notify us of changes of address promptly. At least notify the post office since CPN is now mailed first class or air only and issues can be forwarded if the post office district knows you have moved.

LARRY LOGOTETA writes in to notify everyone of his change in address which is now 23861 Whitman Street, Apt. 32, Hayward, CA 94544. He also mentions that despite the increase in prices, he will continue to sell Darlingtonia californica for \$1.29 plus 40¢ postage and two medium-size Dionaea bulbs for \$1.00 which includes postage. Plants and bulbs will be sent anywhere in the U.S.A. by air. Overseas CPN members should write and inquire about special terms. He will try to send your order several weeks after receiving your check or money order.

RECENT LITERATURE

Gorham, J.R., Stojanovich, C.J. and Scott, H.G.: Illustrated key to the anopheline mosquitoes of western South America. Mosq. Syst. 5 (2): 97-156, 1973.
Plants associated with Anopheles species of mosquito belong to the genera Bambusa, Eichornia, Pistia, Chara and Utricularia.

Kondo, K., Kondo, M., and Bogner, J.: The sunshine pitchers. Garden Journal (New York Botanical Garden) 24(1): 14-15, 1974.

This is an introduction to cultivated Heliophora with three fine photos.

Luetttge, Ulrich. Substance transport in Plants. Heidelberg Paperbacks, Vol. 125, 280 pp. Springer-Verlag: Heidelberg, W. Germany, 1973.

Short, medium and long distance transport is discussed along with current hypotheses on vascular element differentiation, vascular-parenchymal pumps, symplasmatic transport through the roots and systems in several genera including Nepenthes species and nectar secretion.

Moldenke, H.N.: Notes on new and noteworthy plants. LX. Phytologia 26(4): 224-226, 1973.

The author discusses Pinguicula pumila f. alba (Florida) along with other southeastern U.S. plants.

Sahashi, N. and Ikuse, M.: Pollen morphology of Aldrovanda vesiculosa. L. Journ. Japanese Bot. 48: 374-279 and plate I., 1973.

In this first report, the operculum was observed to cover each germinal aperture in pollen of Aldrovanda vesiculosa. There is no operculum found in other genera of the Droseraceae.

Saxena, H.O.: The flora of Amarkantak. Bull Bot. Surv. India 12 (1-4): 37-66, 1970.

The records of the flora on Amarkantak plateau (India) indicates the plant Utricularia graminifolia.

Schmidt, W.E.: A 1000 miles of wild flowers in southwestern Australia. Part 2. J. Calif. Hort. 34, 55-60, 1973.

The author discusses many genera of plants including Drosera species which included photographs and habitats.

Van Achterberg, C.A.: A study about the Arthropoda caught by Drosera species. Entomol. Ber (Amst) 33 (7): 137-140, 1973. IN DUTCH.

The author made a short study of the interrelations of D. intermedia, D. rotundifolia and D. anglica regarding possible differences in the composition of the insects caught by these species in the Netherlands.

Yoshimura, K. Studies on the chromosome number and karyotype of Pinguicula ramosa Miyoshi (Lentibulariaceae). Journ. Japanese Bot. 48: 289-294, 1973.

The chromosome number and karyotype of Pinguicula ramosa, which is a very rare endemic species to Japan, was reported: $K (2n=18) = 4L^{st} + 4M^{st} + 2M^{sm} + 2M^{m} + 2S^{sm} + 4S^{m}$. All the meiotic division was normal (9 bivalents were shown at metaphase I). The chromosome number of $2n=18$ is new to the genus Pinguicula.



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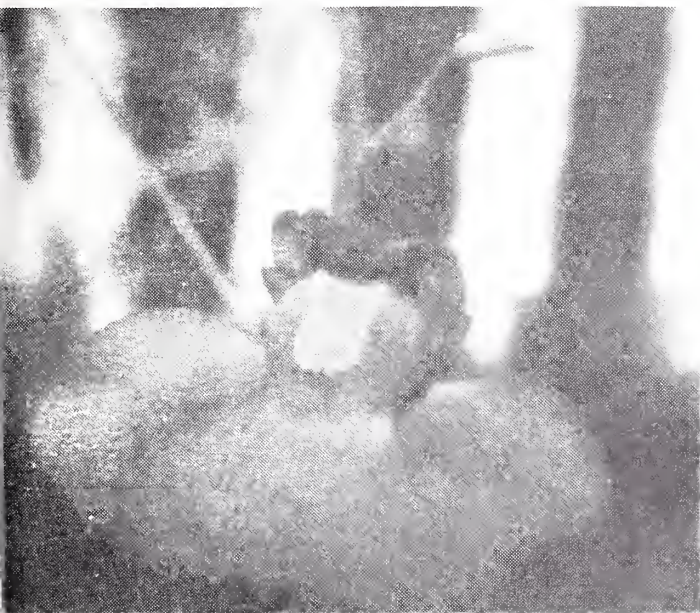


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UTRICULARIA LONGIFOLIA

This picture was made by co-editor Joe Mazrimas in his greenhouse last winter. The species grows profusely but rarely flowers in culture.

NEW SUBSCRIBERS

LEO T. BARBER (617 Third Street, SW, Moultrie, Georgia 31768) has a special interest in flower photography.

GRAEME CHANDLER (Botany Dept., La Trobe University, Bundoora, Vic. 3083, Australia).

GRAY JOHNSON POOLE (1417 Amherst Avenue, Los Angeles, California 90025) is co-author with her late husband, Lynn Poole, of INSECT-EATING PLANTS which is in regular printings and available through many CP outlets as well as bookstores.

R.M. ALBRECHT (Rm 426, Dept. of Bacteriology, University of Wisconsin, Madison, Wis. 53706) states he has long been interested in Drosera and Sarracenia in his native Wisconsin bogs, especially in their microbial flora associations. (See News and Views this issue).

RUBY HARBISON (103 York Street, Morganton, N. C. 28655) teaches botany and related courses on the college level and is keenly interested in native plants.

A. ROGER KIRBY (Rt. 3, Box 470, Granite Falls, N.C. 28630) grows mostly North Carolina CP and is an excellent photographer.

CAROLYN KAY BELTZ (Dept. of Botany, Iowa State University, Ames, Iowa 50010) is studying Utricularia (see News and Views this issue).

DR. HARRY T. HORNER, JR. (Dept. of Botany, Iowa State University, Ames, Iowa 50010).

FRANCES AND MARY MYERS (Route 1, Box 72, Union Grove, N. C. 28689).

R.L. WALLACE (Dept. of Biological Sciences, Dartmouth College, Hanover, NH 03755).

MICHAEL R. VALLO (1620 Grove Street #4, Boulder, Colorado 80302).

ZELIMIR K. TVRTKOVIC SAHIN (Uiterweg 34, Aalsmeer 1210, The Netherlands).

NEWS AND VIEWS

JURG STEIGER is a recent new subscriber with a particular interest in Pinguicula. He sends these comments: "Concerning taxonomy of Pinguicula, by far the best literature is the Pinguicula monography by Casper which describes in great detail morphology, biology, distribution, and cytology of forty-six Pinguicula species. Today Casper's Taxonomy of Pinguicula is considered as the most elaborate one. Ref.: S.J. Casper: Monographie der Gattung Pinguicula (1966), Bibl. Bot. Vol. 127/128 (225 pages). The monography lists over three hundred references on Pinguicula. It is available at E. Schweizerbartsche Buchhandlung (Naegele und Obermiller), Johannesstr. 3A, 7000 Stuttgart 1, Federal Republic of Germany (West Germany). In the meanwhile, a further species was discovered by Malyshev in the USSR (Pinguicula alga).

"I may just report that I have determined the chromosome numbers of the following two species: P. vallisneriifolia $2n=16$, and P. macroceras (material of northern California) $2n=32$. I assume those are reported for the first time. [By the way, the chromosome number of P. planifolia reported "for the first time" by K. Kondo in 1973 (see last CPN page 14) was already determined and published by Godfrey and Stripling in 1961 (Amer. Midland Nat. 66 (2), pages 395-409)]. It is of special interest to notice the differences of chromosome numbers between P. macroceras ($2n=32$) and P. vulgaris ($2n=64$), as both species are mixed up in some literature. See also: S.J. Casper: On Pinguicula macroceras in North America, Rhodora, Vol. 64 (1962) pp. 212-221. Even without knowledge of the chromosomes, Casper supported by morphological reasons the viewpoints of Link, that P. macroceras is distinctly different from P. vulgaris.

"Some of my Pinguiculas need artificial cooling in a self-constructed plant growth chamber. They grow excellently without any daylight under the following light source: Philips Mercury Lamp HPLR-N (125 watt). This light has a slight ultraviolet spectrum portion and almost no infrared so that the enlightened environment is hardly warmed up."

R.M. ALBRECHT has been studying microbial flora in Wisconsin S. purpurea and has found the microbial activity of active mature pitchers to be astounding, warm days of late summer encouraging 10^8 and 10^9 bacteria/ml. fluid. These bacteria are probably adventitious, having "ridden" in with the prey and grown in the temporarily elevated pH of around 7 or above. These arrivals seem to displace more "exotic" species that are present in relatively low numbers during cool temperature periods when the fluid has low organic content and fluid pH is about 4.

THE CO-EDITORS apologize for a monumental error of omission in the U.S. Droseraceae culture article in the last CPN (III, pp. 19-21). We are well aware that Drosera linearis requires special conditions but somehow left these out. This species is unique in that it grows in marly, alkaline bogs or lake margins of the north country. Consequently, a neutral or alkaline growing medium works best, particularly a mixture of sand and vermiculite. Any change in conditions during the summer growth period tends to induce dormancy with hibernaculum formation which might be mistaken for plant death.

Tote Em in Zoo indicated to us that they sell carnivorous plants only in large orders. This means ordering plants in lots of 100 or more per species desired. Their profit margin on small orders is nil and so they wish to receive only large orders of plants from now on. Perhaps several collectors can pool resources and benefit from the low prices offered on this basis.

STEVE KAPA writes that three enthusiastic students came to his class offered on the care and feeding of CP. They each received five Drosera species and a Dionaea in a gallon jar. He also reports that he finally germinated two seeds of Byblis gigantea recently although one seemed to succumb to damping off. He scorched these seeds by burning some tissue paper over them and had a control group which he scratched with sandpaper. Only the burned seed germinated after three months of neglect. Byblis liniflora seed was much more reliable with 80% germination within three months (they were not scorched).

ARMANDO SIMON writes that he grew a Dionaea plant which had a trap with six trigger hairs on one lobe and four on the other lobe. The majority of the traps have four trigger hairs in each lobe of the same plant. Armando also recently visited Europe and many of the botanical gardens. He found about a dozen Nepenthes on display at the Palmengarten but nothing else in the public areas. He feels the Hortus Botanicus of Amsterdam had by far the best collection. All plants were growing very well and most genera were well represented except for Pinguicula where there was only P. caudata and P. gypsicola. The curator at Hortus advised Armando to visit Brussels which he felt to be tops, but he was unable to do so. Armando was disappointed with Kew's CP, although the grounds were horticulturally magnificent. Kew did have Dionaea, six Droseras, Drosophyllum, five Pinguiculas, and a pretty good representation of Nepenthes, Sarracenia, and two Cephalotus. The Paris collection was termed pathetic with most of the plants apparently dead. He was unable to see Zurich. Finally, Armando notes that Ripley's Believe It or Not claims that Dionaea kills its prey by electrocution!

Several CPN members, namely LEO SONG and CARL FORST, related to us the good results that they were getting on controlling fungus and mold infections in carnivorous plants. The product that they use is relatively new on the market with the trade name of "Benomyl." It is a greyish-white powder that is relatively expensive (2.5 ounces for \$5.00 U.S. currency). However, its systematic action seems to control various types of mold and fungus without any untoward effects on the plants themselves. It should be stressed that this compound is still being used cautiously on the different genera of CP to test its possible toxic effects on plant growth and normal leaf development. You will recall a previous article by Leo Song on the deleterious effects of another systemic compound called Cygon E on various Drosera species. The use of this systemic compound seems to prevent black rot in Nepenthes cuttings during the process of rooting. It also seems to protect Sarracenia rhizomes from rotting during unseasonal warm temperatures during the dormancy period. Furthermore, it controls fungus spotting on Utricularia leaves without any harm to the plant itself. Seeds and seedlings could also be treated with this compound to prevent early demise due to damping off. Finally, for those of us who cherish the looks and utility of living sphagnum moss, there seems to be no damage caused by this material on the moss itself. Benomyl is also sold under the trade name "Benlate" which is manufactured by DuPont. It is sold as a 50% wettable powder and when used in a concentration of one teaspoon per gallon of water, it is useful in preventing fungus during stratification of seeds. Seeds of Sarracenia are soaked in the solution and stored damp in the refrigerator for several months before removing them and sowing. Perhaps seeds of Drosophyllum could also benefit with an overnight soaking with this solution before sowing them. Then, to prevent damping off in the seedling stage, the plants could be sprayed often until the stem hardens. The only adverse reaction that was observed so far was in Drosera adelae with the result that new growth was abnormal for a while but subsequently the new leaves looked normal so the effect was not permanent.

CAROLYN KAY BELTZ is a new subscriber and send us this information: "During the past three years I have studied the development of the aquatic carnivorous plant Utricularia macrorhiza. For two years four very different aquatic habitats were monitored for general water chemistry, lake morphometric features, and plant and animal associations. Plants from each habitat varied somewhat in general gross morphology. Consequently, plants were transplanted to see if individual differences were environmentally controlled or genetic. The results strongly implicated an environmental influence. In addition, plants for all stages of development were collected from each habitat and processed for light and electron microscopy. Histochemistry was carried out at the light microscope level for carbohydrates, proteins, and nucleic acids. Fluorescence microscopy was used to identify nucleic acids, and specialized cell walls, including lignification and callose. Further observations were made at the transmission electron and scanning electron microscope levels. By combining these microscopic results it was possible to diagrammatically represent the possible pathways available for movement of water, secretory products, and ingested products in the trapping organs of the plant. These path-

ways were based on cell wall types, cuticle, gland structure, and location of plasma-desmata. Although the investigation was not primarily physiologically oriented, it eventually provided valuable information for understanding the functional aspects of the plant."

The 1974 Cornell Garden Show was held May 12, a rainy overcast Sunday, but 2,000 people came. Of particular interest was the carnivorous plant exhibit and RUTH NETHERTON sends news: "What do they eat? That's the question asked by most of the people upon seeing the carnivorous plants display. After explaining how the various types of CP capture prey, people would take a closer look at the exhibit.

"The display was composed of two terrariums, several copies of the Carnivorous Plant Newsletter, and books by Lloyd, Darwin, Poole, Erickson, and Pietropaolo. One terrarium contained Sarracenia purpurea, S. alata, S. drummondii, Darlingtonia californica, two Drosera rotundifolia, and a Pinguicula. The other terrarium held S. purpurea, D. californica, Dionaea muscipula, Drosera binata, D. rotundifolia, D. spathulata, and three Pinguicula specimens. Fortunately, one of the pitcher plants was in full bloom as well as several others with buds. All of the Pinguicula and several Drosera were in flower. People kept saying that they had no idea the flowers were so pretty.

"One of the things that really was surprising was the number of questions on culture. Why don't my fly traps turn red? Why did my Venus fly trap grow beautifully for a couple of months and then just die? What type of soil do you grow your plants in? In addition, quite a number of people took the addresses of carnivorous plant nurseries and the mailing address of the Carnivorous Plant Newsletter. So possibly there were a few converts to the fascination of raising carnivorous plants.

"The Cornell Garden Show was sponsored by the Cornell Garden Club, an organization of students majoring in, or interested in, floriculture and horticulture. The faculty advisor is Dr. Robert G. Mower. Helping specifically with the CP exhibit were Larry Hollar, Pam Wool, Carolyn Klass and Ruth Netherton."

While in the vicinity of Bass River Forest in the New Jersey Pine Barrens, DAVE KUTT along with RICH SIVERTSEN found some plants associated with Drosera intermedia and D. filiformis that look very much like the Drosera x hybrida described long ago by J. M. MacFarlane (Contr. Bot. Lab. Univ. of Pennsylvania. 2: 87-99, Pl. 12. 1899) and felt by him to be a hybrid between the two Droseras mentioned above. DON SCHNELL made a trip to the area along with Rich Sivertsen some time later and found similar plants, although a bit more variable. Dave Kutt has noted variants that range from plants looking more like D. filiformis (but still tending toward intermediate) to plants that are downright intermediate between the two putative parents. They occur in clumps among the parents, or individually. The flowers are white, intermediate in size and morphology between the other two Droseras, and the leaves have relatively long petioles for the blade which is wider than D. filiformis and with a more rounded end in the plants that are most intermediate. Interestingly, the intermediates have a stem up to 2.5 cm. rather than the low, buttonlike rosette of D. filiformis, this being more like D. intermedia. None of the plants could possibly be interpreted as an elongate leaf form of D. intermedia. Some initial attempts to hybridize D. filiformis with other Droseras (D. capillaris, D. intermedia--Schnell and Sivertsen separately) have met with sterile seed while control species seed germinated readily. It will be important to continue the studies of the x hybrida plant, especially whether it is sterile, and to continue efforts to produce artificial hybrids.

DR. WHERRY has sent some comments: "One of the remarkable phenomena in the carnivorous plant world is the use of the liquid in Sarracenia purpurea pitchers by mosquitos of the genus Wyeomyia for their life cycle - in that not only must the larvae have developed resistance to the digestive action of the plant, but also obtain resistant organisms as food. There has now appeared in the journal Ecology, vol. 55, No. 3, p. 475 a study of this subject: "Predation and prey community structure, an experimental study of the effect of mosquito larvae on the protozoan communities of pitcher plants," by John F. Addicott of the University of Alberta, Edmonton 7, Canada. The studies were made in bogs near the University of Michigan Biological Station in Cheboygan County, Michigan. In one bog mosquito larvae were virtually lacking, permitting comparison with others in which they were abundant. The effects of predation by the larvae proved to be highly complex, so it was concluded that more experiments will be needed before generalizations as to the relationships can be made. The study represents, however, an interesting application of carnivorous plant natural history.

"The study of the distribution of Darlingtonia on p. 25 (Vol III CPN) is interesting in demolishing the often repeated notion that this is a "mountain" plant--copied from one book to another--since there are more lowland than upland colonies. And the many occurrences on ultrabasic rocks emphasizes another point that I made in criticizing Wylie's notion that the prey is of no value to the plants! The soils of ultrabasic rocks are

deficient in nutrient elements, which carnivorous plants can get from their captures."

In a recent letter, DAVE KUTT sent in some hints for growing CP as follows: (1) When budding leaf cuttings of Drosera or Pinguicula, the annoying and wasteful curling of the cuttings can be prevented by placing them on a mound of sphagnum, then stretching a single layer of cheesecloth over the whole thing. The budlings grow very well through the cloth. (2) For two years, he has found that small quantities of tropical fish food are useful for "feeding" Sarracenias, using the dead insect or ant egg types. (3) He feels that the end of season trimming of old Sarracenia pitchers should be reserved until they are entirely dead brown since live pitchers may yet contribute some nourishment. (4) He has confirmed an original Japanese idea of pot-nesting when trying to grow cool or montane plants in culture; that is, an outer clay pot filled with coarse perlite, and an inner pot of growing medium. The perlite is watered daily and evaporation through the clay and porous perlite is cooling. (5) He has been using foliar feeding with dilute fish emulsion and other fertilizers prior to the CPN discussions; in the case of pitcher species, applying the material on and in the pitchers.

SHORT NOTES

SARRACENIA--DESTRUCTIVE INSECT ASSOCIATES: A SUMMARY

by D. E. Schnell

Again by reader request, we are called to typewriter to discuss a curious group of insects who have managed to bypass the fate of their brethren in Sarracenia traps, and who would be known as pests by the strict horticulturist but which are quite fascinating in a broader perspective. Granted, this perspective has limitations. A good friend and botanist once introduced Exyra moths to his greenhouse collection for interest sake. Interest soon threatened decimation and the then unwelcomed guests were removed only after much time and effort. In nature, however and as always, there are the inevitable countercontrols and the ecologic relationships of these insects which provide endless hours of satisfying study.

Even though I have studied and dealt with all the insects to be described and more, this note is not really mine after all. Frank Morton Jones, a prominent entomologist of the first third of the century, first summarized and added much to our knowledge of these larvae. His observations are keen, pertinent, and presented in a refreshingly clear style in his writings. In addition, the papers have many fine line drawings illustrating the parasites and their activities and they should be consulted for complete information. Here we only have space for the briefest summation and some remedies for infestations of closed collections. A selected bibliography is presented at this note's conclusion.

EXYRA. In the conservatory and greenhouse, this moth is the most troublesome of all and will be mentioned first. The adult is a diminutive noctuid maximally about 1.5 cm. across and with yellow and black markings. The adults are of course harmless, the larvae being the culprits. There are three species involved: E. rolandiana which principally infests S. purpurea in northern reaches; E. ridingsii confines itself largely to S. flava; and E. semicrocea is cosmopolitan throughout the south. The moths conceal themselves inside the opened pitchers, always head up, and overcoming the usually fatal slide of the waxy inner surface of the upper pitcher. When disturbed, it will back down the pitcher and dodge about. If finally forced out, it will immediately seek the safety of another nearby pitcher. Small, corrugated orange eggs are laid, usually one to a pitcher. The larvae are brightly striped purple and white and the two southern species have peculiar lateral tubercles or lappets which help prevent their being wedged into the depths of the narrower southern pitchers.

Larval destructive activity is of two types, there being some variance according to species and climate. (1) An overwintered larva of late instar leaves the dead debris of last year's pitchers and climbs to the apex of an opened pitcher, chews its way in, girdles the inner layer of leaf tissue which prevents pitcher opening and undesirable intervention by other insects and rain. (2) A newly hatched or late instar larva of previous season enters or hatches in a newly opened pitcher where it spins a web across the mouth, and then proceeds to eat the inner layers of the leaf, always leaving the outer intact. This papery upper portion of the pitcher collapses and again provides a seclusive seal. So, infestation is immediately suggested at a glance by unopened pitchers with pinched dry tops, and opened pitchers with dry tops fallen over like empty cloth sacks. Investigation inside reveals the larvae and a great deal of bright orange, corky frass refuse in the bottom. As one might expect, it has been shown that these larvae produce anti-proteases.

Pupation has some interesting aspects. It occurs in the layer of frass. But before pupating, the larvae open two holes: one very low to drain any water that might get in, and one above the frass for later egress of the adult moth which does not have the mouth-parts to chew its way out. No adaptation is infallible. Certain birds have come to

recognize the meaning of the telltale holes and slash open the pitchers near the bottom to feed on the pupae. In the late fall, one can see the slash marks on the aging pitchers with their collapsed tops. And that is not all there is to infallibility. The natural burning of yesteryear in bogs and savannahs, and intentional controlled burning by the ecologically minded today, will effectively destroy the overwintering larvae and pupae of E. ridingsii. Strike, counterstrike, and now another strike: E. semicrocea frequently overwinters or pupates outside of the pitcher very low to the ground and effectively insulated from the rapid fire.

Well, what to do in one's collection when the dreaded signs appear. First, search all the opened pitchers for the progenating adults, remove them and destroy them. This is no easy task in such as S. minor with its closely approximated hood. (But no adults will be found in S. psittacina.) When you have found and destroyed the adults, and perhaps there are none if your plants recently came in with eggs or larvae only, then you must open or clear the webbing of all infested pitchers and seek out the larvae. There is always only one per pitcher. If it evades your probing forceps, pinch the pitcher where the larvae lies, destroying him in situ and providing some extra protein for the beleaguered Sarracenia as well. Try to leave as much pitcher as possible for photosynthetic reasons at least. The eggs and larvae will appear in succession as they were laid, so an entire summer may be spent clearing up a serious infestation. Inevitably, some pitchers will have to be sacrificed. In the fall, do clip all old pitchers, remove all surface debris, and destroy this material away from your plants. A few early instar larvae may overwinter among the buds and scales of the rhizome, but you can catch these early the next year and pretty well have things under control.

Prevention is worth...etc. etc. All newly acquired Sarracenias should be quarantined away from your collection because the eggs are nearly invisible to the naked eye. I would even suggest shearing all new plants of all mature and maturing pitchers even though this will set back growth another year. It will save a lot of trouble and damage.

PAPAPEMA APPASIONATA. The Sarracenia root borer larva grows rapidly to be about 5 cm. long and can do much hidden damage deep within the rhizome. Its hallmark is the conical pile of bright orange droppings or frass at the apex of the rhizome which grows larger day by day. These conical piles of material are difficult to see in the field where there is much debris from the previous years around the plant base, but the larva activity is quite apparent in culture. The rhizomes are usually acquired already infested or with the egg, so the adult poses no problem. The larvae can be extracted in one of two ways. (1) Actually probe into the borer's cavity with a long narrow forceps and pull it out; or (2) inject a dilute solution of Malathion into the cavity. (The latter is an elegant suggestion by Joe Mazrimas, but I have found it considerably more satisfying to do forceps to body battle with the larva.) Usually, enough rhizome is left so that the plant is saved, though considerably smaller and requiring some care to prevent rot via the raw borer cavity.

SARCOPHAGA SARRACENIAE. This dipterid is really no problem but might cause some consternation to the uninitiated. The larva is a maggot that lives in and on the decaying material in the depths of an active pitcher. It does no harm but is interesting in its resistance to the usual digestive activities. There may be from one to five larvae on the average and they should cause no worry; they will not seriously deprive the plant of any nutrients. Local people tell of going through their fields, opening the "wild lillies" and removing the larvae to be used as fishing bait.

NEOSCIARA MACFARLANEI. A diptera similar to the previous, but it is rarer and can only be damaging to the extent that it does close an infested pitcher with a fine, frothy web. However, it does feed on the decaying debris and not the plant tissue, and usually the pitcher has caught enough prey to be physiologically useful for the season by the time the larva closes it. This insect can be eradicated by destroying the larvae as described for Exyra.

ISODONTIA PHILADELPHICUS. This wasp is of special interest to entomologists because it engages in the rare practice of grass cutting to prepare nests--in Sarracenias, of course. The pitcher is found to be filled by alternate layers of grass plugs with intervening chambers of an egg or newly hatched larva and a stunned food insect, usually a cricket. There may be three or four such chambers per pitcher. Of course, the pitcher is out of commission, but again the infested pitchers are comparatively rare. I have been privileged to observe and photograph this insect only a few times over many years in the field.

LARVAE THAT ATTACK SARRACENIA FLOWERS. These are detected in two ways: (1) the dead petals hang on the flower because they are bound there by webbing; (2) one can observe the destruction of the ovary after petalfall. There are two principal moth larvae involved, although many others may appear adventitiously. One is our old friend Exyra exhibiting some diversification. The other is Olethreutes daeckiana. Both are easily searched out, or if the ovary is destroyed anyway, remove the flower.

CONCLUSION. This about covers the basics of the most prominent damaging insect associates

of Sarracenia. However, there are more--more parasites and commensals and opportunists which I have observed and read about. Perhaps your field studies will be equally rewarding. After all, the Sarracenias themselves are but one part of the well-cliched and now proverbial web of bog and savannah life, a web that grows more fascinating and complex the deeper we probe.

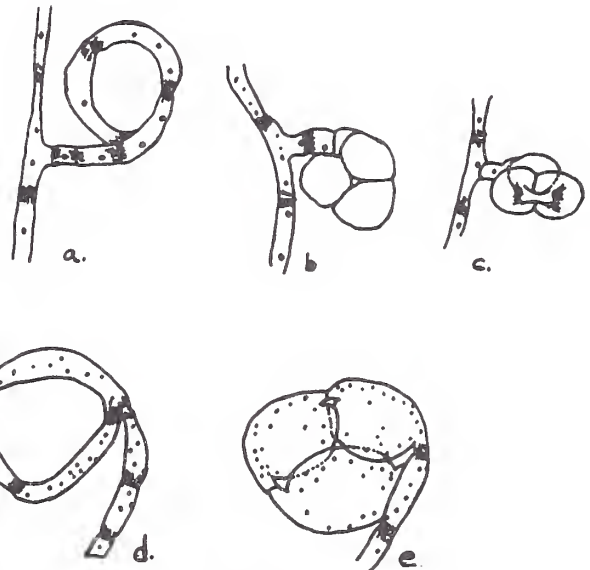
SELECTED REFERENCES. (The first six articles, available in any good biological library, are "musts" with their excellent narrative and descriptions coupled with fine drawings. The last is in a limited edition folio book which may be hard to find, is summary of the first six articles, but lacks the details and drawings.)

- Jones, F.M. Pitcher-plant Insects. Entomol. News 15: 14-17, 1904
 - - - - - Pitcher-plant Insects--II. Entomol. News 18:413-420, 1907.
 - - - - - Pitcher-plant Insects--III. Entomol. News. 19:150-156, 1908.
 - - - - - Another pitcher-plant insect. Entomol. News. 31:91-94, 1920.
 - - - - - Pitcher plants and their moths. Nat. Hist. 21:296-316, 1921.
 - - - - - In ILLUSTRATIONS OF NORTH AMERICAN PITCHER PLANTS (Mary Vaux Walcott),
 Smithsonian Inst., Washington, D.C. pp. 25-34, 1935.

CARNIVOROUS FUNGI
by Jacques Haldi

In the vegetal world which surrounds us, we are surprised by the variety of the carnivorous aquatic, terrestrial or epiphytic plants. We are much more surprised to know that some fungi, indeed microscopic, as for instance Arthrotrichs, Dactylella (which forms collars), and Dactylaria (which forms adhesives) are all carnivorous. They are specialized in the capture of nematodes which constitute the obligatory element of their food.

There are two types of snares: one by adhesives and the other by collars. The fungi which capture with adhesive catch the worms by contact, similar to the Pinguiculas, the sticky glands fixed on peduncles which if lightly rubbed by the worms quickly secretes an acid liquid which goes quickly through the worms. The other fungi have a more crafty and efficient system with the collars that possess the digestive glands composed of three parts as in Fig. 1. The fungus forms a ring with a sensitive surface on the inside which on contact makes a reaction as in Fig. 2. The three parts of the ring increase in volume very quickly (around three times their initial volume) so that the worm finds itself squeezed in and a second. I don't know if the collar compression, these three parts go over contents. We can vary the number of of nematodes in solution. The culture a gelatinous substance. So in nature, number of snares.



a, b, c = ARTEROBOTRYS DACTYLOIDES a et d : fig 1
d + e = DACTYTELLA DOEDYCOIDES b, c et e : fig 2.

the worm finds itself squeezed in and finally in complete immobility in a few tenths of a second. I don't know if the collars return to the initial shape after digestion. By compression, these three parts go very strongly through the nematode emptying it of its contents. We can vary the number of collars in culture by adding or reducing the number of nematodes in solution. The culture is composed of a number of nutritive elements in a gelatinous substance. So in nature, it is the number of victims which determines the number of snares.

MISCELLANEOUS OBSERVATIONS ON THE MORPHOLOGY AND NUTRITION OF PITCHER PLANTS

by John Lindquist

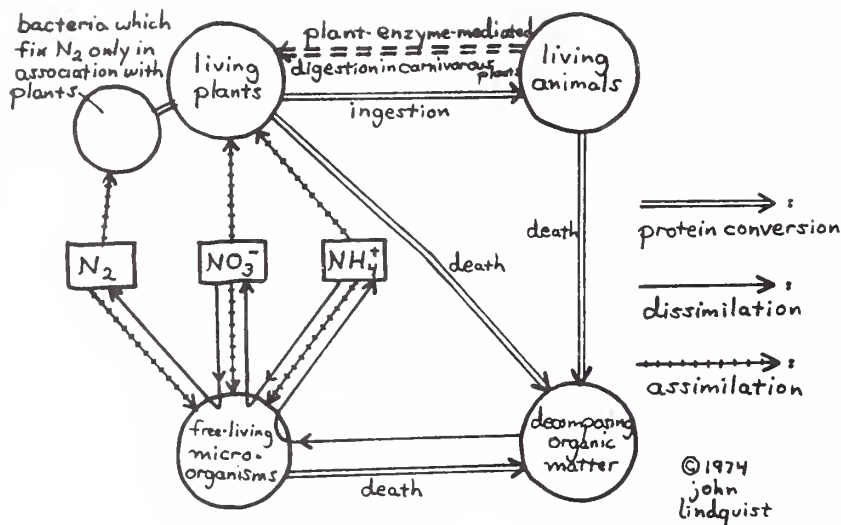


fig. 1 Abbreviated, generalized nitrogen cycle
in nature

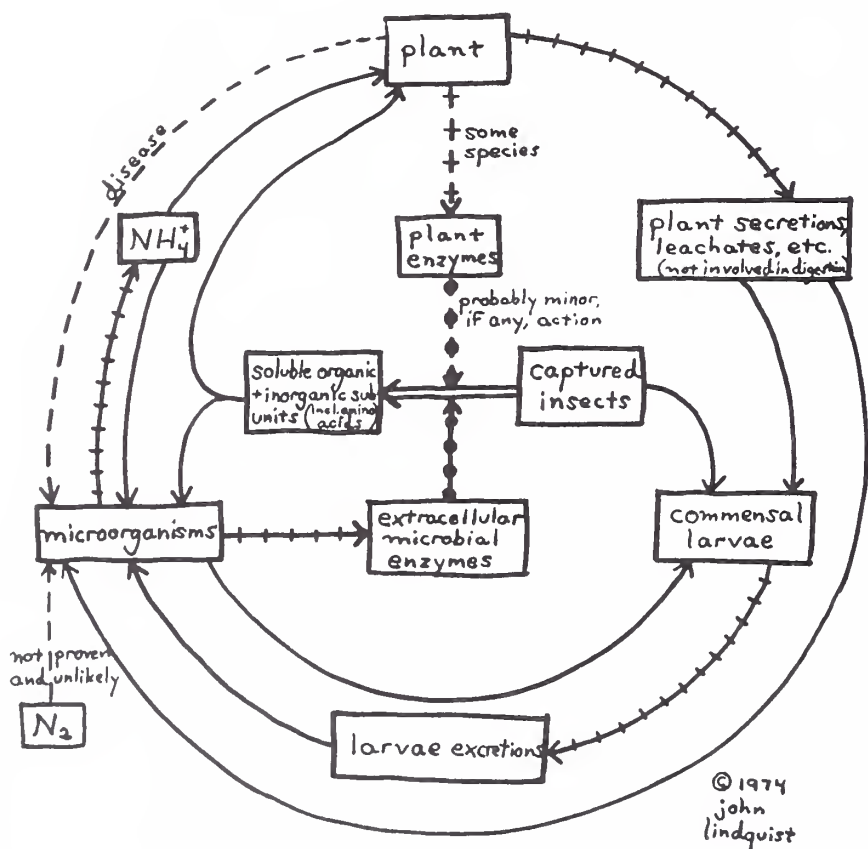


fig. 2 Activities within pitcher plant

- ====> : conversion
- > : utilization
- ++++> : production
- > : enzymatic action

I've done some field observations in a relatively shaded and dry bog near Madison, Wisconsin and a relatively open and wet bog near Drummond, Wisconsin, only about 320 miles north of Madison but in a quite different climatic area. One of the more striking differences between the pitcher plants of these two bogs in the middle of summer is the venation and other anthocyanin coloration of the leaves. Whereas the mature, open leaves of the shady bog are generally green without noticeable red venation, the mature, open leaves of the sunny bog are very heavily veined with the pigment often spreading in broad patches over much of the leaf. Naturally this is explained by the fact that intense sunlight and cool weather (the nights being cooler in the north) enhance anthocyanin production; plants in the bog near Madison increase in venation with decreasing shade and cooler weather as winter approaches. Under the snow the leaves appear maroon, but they assume their fall coloration after the snow disappears and warmer weather returns. Just what percentage of these overwintering leaves ultimately survives through the following summer I do not know; new leaves tend to become dominant.

There is a narrow band below the hairy area inside the hood of *S. purpurea* (zone 2 according to Lloyd (1942), p.21) which becomes quite red, and its coloration does not always coincide with the venation. So far I haven't found any explanation for this.

My particular interest in pitcher plants is primarily the bacteria which inhabit the pitcher. My M.S. thesis, tentatively titled "Preliminary Studies on the Bacteria of the Pitcher Plant *Sarracenia purpurea*", now in preparation, includes a treatment of the types, numbers and probable activities of the functional and exotic microorganisms in this unique niche which, by the way, has been neglected by plant microbiologists for too long! My being a full-time lab instructor has greatly restricted my activities as far as what I

would like to do with this project is concerned. On the few days I've been able to go "bogging" (weather is also a factor), I've been driven out of the bog twice by surprise thunderstorms and once by gunfire. It is no fun trying to pipette pitcher fluid, do pH readings, etc. while crouching to avoid the projectiles of careless target shooters. As if the project itself isn't exciting enough...

Once in awhile I am able to use pitcher plants to explain the nitrogen cycle to the students. Somewhat expecting to be met with derision by the more "sophisticated", I continually find that the students are fascinated. My small CP collection (S. purpurea—both subspecies, S. flava, D. californica and D. muscipula) is not only decorative but also of considerable educational value.

I would like to offer two "cycles" of mine which I hope will help to explain the nitrogen cycle, not only in nature but also in the pitcher plant. Figure 1' is basically a new variation on an old theme; here dead microorganisms are considered part of the pool of decomposing organic matter. Also, where plant enzymes do the entire job of digesting insects, which is probably the case in Dionaea, is indicated by the dotted-line arrow, being a very minor part of the overall scheme. In Figure 2, which is more detailed and especially relevant to pitcher plants, commensal larvae (e.g. Wyeomyia smithii in S. purpurea) are shown to take some part in the activities within the pitcher; if they die in the pitcher they are then treated as "captured insects." The reason I indicated nitrogen fixation as being "not proven and unlikely" is because trace amounts of ammonia generally tend to inhibit nitrogen-fixation, at least of the Klebsiella or Azotobacter type. Plant leachates are indicated because they are highly important in providing nutrients for bacteria and fungi on almost any plant with a drop or film of water on it.

I put much emphasis on the fact that plants take in ammonia as well as nitrates, and certainly in carnivorous plants the intake of ammonia from insect digestion can be of considerable importance, possibly more so than intake of amino acids, depending on the species. According to a recent science yearbook, plants can absorb approximately 10% of their nitrogen requirement as ammonia through their leaves. Dionaea, however, which probably doesn't rely on bacteria for any part of the digestion process, most likely doesn't absorb ammonia from digestion, unless the prey is overly large and rots.

In the literature on carnivorous plant enzymes, many papers, old and new, have characterized digestive enzymes which were probably partially or totally contributed by bacteria. Here is an area in plant science that demands some intensive research by plant physiologists and microbiologists!

NEPENTHES AND THE PHOTOPERIOD

by J.A. Mazrimas

Healthy Nepenthes plants are relatively easy to grow providing that one supplies a few essential conditions. Usually you can receive a plant either rooted, or as a cutting that must be rooted and established in its growing container. Here are some rules that I follow to give large-pitched plants:

WATER. I use plain tap water on my plants which is moderately hard, but I'm careful to use only warm water--about 60° F--or else I add hot water to it from the tap.

PROPAGATION. If you receive a cutting, it is a good idea to peel one-inch strips of epidermis from the end and dip it in Rootone (a hormone powder that accelerates root growth and usually contains a fungicide to prevent stem rot). Dipping the entire cutting in a solution of Benomyl or Benlate solution for a minute or two is also beneficial in preventing fungus and mold problems that may develop during the rooting process.

MEDIUM. I use only sphagnum moss because it is an ideal medium for retaining water and allowing good drainage as well as providing an acid medium. A mixture of coarse sand and peat with perlite will also suffice. The latter mixture requires water more often than the moss.

POT: I use only plastic pots or buckets with large size drain holes. It is important to use a large planting container for Nepenthes since the black wiry roots are rather extensive and seem to grow almost exclusively around the perimeter of the pot. Use a six-inch pot for new cuttings and an eight to ten-inch container for a rapidly growing year old plant. A plant 3-4 feet high must have over a six-inch pot in order for the roots to have room to grow. Well-established plants grow well in a ten-inch diameter plastic bucket with large drain holes cut into the sides.

ROOTING A CUTTING:

Over the cutting, place a plastic bag which is

supported on stakes that are placed around the pot. Set the plant in a warm location in a well-lighted area. In about two weeks, take a peek to see how the plant is progressing but refrain from adding more water to the moss unless it looks very dry. Nepenthes root better in an airy, well-drained medium that is kept moist but not soggy. Replace the bag. In about 2-4 weeks you should observe new growth showing that rooting has initiated so that supplies of water can be increased.

FERTILIZER. Nepenthes plants respond very well to dilute amounts of fertilizer (either organic or inorganic) fed every six weeks to the roots during active growth (summer). This feeding does not limit the number or size of pitchers as is popularly believed. Don't over-fertilize.

HUMIDITY. Most Nepenthes will grow and form pitchers in ordinary greenhouses that maintain a relative humidity between 50 and 80%. If you do not have a greenhouse to grow Nepenthes, then I suggest construction of a simple rectangular box constructed out of 1" x 3" lumber and covered with 6 mil polyethylene sheeting. Standard fluorescent lighting should be installed with at least four 4-foot cool-white or Gro-lux lamps. A timer could be added for convenience.

TEMPERATURE. Usually, a night temperature of 65° F. is considered minimum and a daytime temperature of 70-85° F. is optimum but the lower range is desirable because the relative humidity remains higher.

LIGHT. In my opinion, this factor turns out to be the most important not only for growth but also for good pitcher production. Low light levels seem to produce weak growth and only a few pitchers. Medium light levels (about 40-50% full sunlight for 75% of the day) seems to promote not only the growth of stem and leaves but also good pitchers as well as many flower spikes. I also think that the length of photoperiod determines the onset of pitcher production during the coming season. In its native habitat for millions of years, Nepenthes geared itself to a constant flux of solar radiation throughout the year. The photoperiod doesn't vary more than 30 minutes in 12 hours between dry and wet seasons. However, as we proceed northward from the equator, the day length varies depending on the season. As we approach summer, the day length increases daily from about 9 hours in winter to as much as 14 hours at the 30° parallel and 16 hours at the 50° parallel in mid-July. The 30° parallel crosses the state of Florida while the 50° parallel crosses the U.S. - Canadian border. Here in California, onset of new pitchers takes place in June while in more northern states, new pitcher production should begin much earlier if the plants are grown under natural light. This is due, I believe, to the day length reaching the 12 hour level sooner than in the southern states. Pitcher production on new growth then ceases when day length falls below 12 hours. However, if you wish to have pitchers all year around, then you must grow the plants under artificial light, setting up a 16-18 hour light schedule. It may only be necessary to light the lower leaves of the plant while allowing the top to grow above the lights. The top growth still produces pitchers in my greenhouse despite the fact that the top portion might be 2-3 feet above the light fixtures.

SPECIAL NOTICES

KING'S PARK AND BOTANIC GARDEN (West Perth, Western Australis, 6005) which has been listed as a seed source in CPN in the past, wishes some clarification to be made. First of all, the Garden does not send plants to private individuals under any circumstances. Secondly, seeds are scarce due to wet seasons recently; in fact, there has been no Cephalotus seed for three years and will be none this year. They have an annual seed list in October of each year (there are no CP listed for 1973, so wait for the next issue of October, 1974), which you may purchase for 65¢ (surface, overseas), and seeds are \$1.00 per packet, surface--air mail extra. DO NOT ORDER CP SEEDS WITHOUT CONSULTING THE UPCOMING GARDEN SEED LIST FOR 1974!

! SUBSCRIPTION RENEWAL NOTICE !

The time has again come for renewal of CPN. In order to conserve funds and effort, we do not send out bills, so please heed this notice to re-subscribe for Volume IV right now. Subscription is by the entire volume. This year, we have the subscription blank in the back of the newsletter and it is not paginated and there is no CPN material on the back of the blank, so you may remove and return the entire blank without disfiguring your CPN. This year we also have a poll attached to the blank in order that we can ascertain in what sort of direction CPN should go. The response to the newsletter has been and continues to be fantastic, so increase your satisfaction with CPN by completing the poll and mailing with your renewal check. PLEASE HAVE ALL RENEWALS IN BY FEBRUARY 1, 1975! We will remind you once more next issue about renewal, but this will be the only renewal blank and poll supplied.

All CPN members who ordered the Japanese CP books should have received them by this date. As mentioned before, no new orders can be taken at this time until a new announcement appears in a future CPN issue. One more book on the list is now "out of print" and another is "out of stock" so those people who ordered these books can consider themselves lucky to receive their orders. We regret that some orders could only be partially filled because of the fact one book was "out of print" rather suddenly before the list could be modified. Refund checks for this book should have been returned by now to those who were affected.

If a unilateral exchange of plants is carried out, we feel that the receiver should compensate the sender with the cost of the postage plus a little for the packaging. It would also be considerate if after receiving the package of plants, a little note be sent acknowledging the safe receipt of the plant package as soon as possible. This way, the sender wouldn't have to worry about the outcome of his effort and generosity. These are just a few kind tips to those people who desire plants but weren't sure of the customs regarding unilateral exchange.

RECENT LITERATURE

Ah-Lan, Lim, Prakash, N.: Life History of Nepenthes gracilis. Malays Jour. Science. 2: 45-53, 1973.

The biology of the anther and dehiscence of the pollen tetrads which are viable for three days after anthesis are discussed. Also, the development of the ovule and maturation of the seed embryo is described. The seeds are viable only for about a week after the fruit dehiscence and germination takes place in about a month. Seedling characters are also described.

Beltz, C.K.: A developmental study of the bladders of Utricularia macrorhiza. Amer. Journ. Bot. (5) 61, 4, Supp., 1974.

Gross morphological changes in the bladder color, size, length and ability for the plants to flower were noted with plants taken at different locations.

Beltz, C.K., Horner, Harry T.: Possible pathways for the secretory and ingestive products of the bladders of Utricularia macrorhiza. Amer. Journ. Bot. (5) 61, 5, Supp., 1974.

Both the chemistry and physiology of digestion in this organism is discussed.

Casper, S.J.: Eine neue Pinguicula-Art aus Mexico. Fedd. Rep. 85 (102). pp 1-6 + 1 plate. 1974. IN GERMAN

Pinguicula kondoi sp. nov. (Lentibulariaceae) from Mexico is described. This species is named after Katsu Kondo, and is a member of subgenus Isoloba, section Heterophyllum. The chromosome number is $2n=22$ determined by Katsu Kondo.

Cody, William, Talbot, Stephen: The pitcher plant Sarracenia purpurea L. in the northwestern part of its range. Can. Field-Nat. 87 (3): 318-320, 1973.

The history of collection reports of the above species from Alberta and British Columbia (Canada) is recounted. Information on associated plants, habitats at collection sites and a map of central Canadian distribution records are included.

Hansen, Carlo: Note on Drosera rotundifolia L. in Greenland. Bot. Tidsskr. 67 (4): 342-343 (1973)

Now twelve locations are known of this species in Greenland and all plants have a chromosome number of $2n=20$ which agrees with species found elsewhere.

Kondo, K.: Chromosome numbers of five taxa. Chromo. Inf. Serv. No. 15, 33-34, 1973.

The author gives the chromosome numbers for five angiosperms, including two CP: Utricularia vulgaris ($n=21$) and Drosera spathulata Labill. ($2n=40$) with some discussion of the ploids of the latter.

Kondo, K.: The karyotypes of the species of Byblis. Bull. Torrey Bot. Club. 100: 367-369, 1973.

The chromosome counts of Byblis gigantea ($2n=14$, $x=7$) and B. liniflora ($2n=24$, $x=12$) are presented along with ideograms of the two species.

Krizo, Milan: Occurrence of Drosera rotundifolia L. on the Polana in the Slovakmidland range. Biologia (Bratisl) 28 (7): 595-597, 1973.

This species of plant was found in peat sedimentation that depended on the presence of impermeable underlying layers of bentonitic clays.

Lobareva, L.S., Rudenskaya, G.N.: Pepsin-like protease from insectivorous plant Nepenthes. Biokhimiya 38 (3): 640-642, 1973

IN RUSSIAN

A proteolytic enzyme was isolated from the juice of unopened pitchers of a hybrid Nepenthes species and is named nepenthesin. Its properties for digesting protein are very similar to the animal enzyme called pepsin, found in the stomach. In contrast to pepsin, nepenthesin is more stable at neutral pH and further tests confirm that the structure of the active centers of the two enzymes are very much alike.

Maier, Rudolf: Effect of dryness on the ejection of turions in Utricularia L. Oesterr. Bot. Z. 122 (1/2): 15-20, 1973

IN GERMAN

The turions of U. vulgaris, U. neglecta, U. intermedia and U. minor can be released from dormancy by both high temperature and short photoperiods. Even after a prolonged drying, the turions are able to sprout. Inhibition of sprouting is probably best produced by cold water during winter.

Stoutamire, W.P.: Sphagnum. Cranbrook Institute of Science Newsletter. 36: 98-104, 1967. A good paper on the chemistry, anatomy and ecology of Sphagnum mosses in the U.S.; quite pertinent to all CP people.

Sydenham, P.H. and Findlay, G.P.: The rapid movement of the bladder of Utricularia sp. Aust. J. Sci. 26: 1115-1126, 1973.

The authors describe variations in internal pressure, volume, membrane potential and membrane resistance during the firing of bladders of Utricularia. The trap door closes within 10-15 milliseconds after mechanical stimulation. The luminal volume increases more than 40%. The internal hydrostatic pressure increases threefold.

Thurston, E.L., Seabury, F.: Fine structure of the pavement epithelium of Utricularia biflora. Amer. Journ. Bot (5) 61, 65 Supp., 1974.

The utricle door and pavement epithelium of this organism was investigated to determine the origin of the membranous velum and its relationship to the trap door.

Williams, Stephen E., Pickard, B.G.: Connections and Barriers between cells of Drosera tentacles in relation to their electrophysiology. Planta (Berl.) Vol. 116, 1-16, 1974.

The physiology of the tentacle of Drosera capensis was studied which showed that the head consists of a secretory cap that secretes mucilage, an inner layer called the endodermoid layer and a core of xylem in the innermost structure. The stalk that supports the head consists of a layer of outer stalk cells, a layer of inner stalk cells and finally the xylem of the stalk. The authors show that tiny fibers called plasmodesmata unite different cells in the head and stalk which permits the electronic spread of receptor potentials and action potentials between cells.

Pietropaolo, James and Patricia: The World of Carnivorous Plants. R.J. Stoneridge Co., 128 pages, 1974. (Available directly from the author at 4646 Emerson Road, Canandaigua, NY 14424. Cost: \$5.95 plus 35¢ postage US surface)

This soft cover book contains about 60 black and white photos of many US carnivorous plants and a few foreign species; there are some color photos on the covers. The text concentrates mainly on culture and propagation, and there is a long introductory chapter summarizing some of the myths and stories of carnivorous plants which has historical interest. There are many photos of the comparative effects of different growing techniques.

CARNIVOROUS PLANT NEWSLETTER

VOLUME III, NO. 4

DECEMBER, 1974

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FAR LEFT:

NEPENTHES x DYERIANA

NEAR LEFT:

NEPENTHES x WITTEI

EDITORS' CORNER

Even though the question has not been put out as far as we know, there are probably many readers wondering why so many of the short notes in CPN seem to be written by one or both of us, or two or three other old regulars. The reasons are not chauvinism or self-glorification but simply that getting short notes out of our readers is like pulling teeth. Certainly we could get by with fewer or no short notes in CPN, but we believe--and preliminary indications in the recent poll bear us out--that CPN would be far less without these longer dissertations on one subject. But as of this issue, the cupboard of back notes to print is bare.

There is an old cliché that everyone has one good novel in him and we would extend that notion to the effect that every CPN subscriber must have a short note in him. Non-academically associated subscribers need not feel shy--avocational and hobbyist botanists have contributed important material to science for years, and any academic graybeards who may not recognize this do so at their own loss. Professional botanists may think themselves too busy or may not be willing to reveal the world shattering results of project X in this format; but writing one of these notes takes so little time, results in so much, and the subject can touch on something ancillary to your primary research that might not get into a formal journal, or perhaps a needed brief review or overview of your past work since many CPN subscribers may not have easy access to a good botanical library. Also, records of field, botanical garden or museum trips provide interesting and useful information. Literary precision or prettiness is not a factor--we are not a formal board of editors or a prize awarding committee.

So skip the next coffee break, TV program or dull faculty meeting, relax, sit down and write something for CPN.

NEW SUBSCRIBERS

DAVID MCCARN (Box 835, Badin, North Carolina 28009).
 FRANK PETERSON (761 Hialeah Drive, Hialeah, Florida 33010).
 STEVE C. DENNIS (3428 Park Street, Columbia, South Carolina 29201).
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 MAURISSEN GOLER (60 Crittendon Boulevard, Rochester, New York 14620).
 WILLIAM PAUL AUSTIN (St. Gabriel's Episcopal Church, Rutherfordton, North Carolina 28139).
 GEORGE NEWMAN, M.D. (487 Kennard Road, Manchester, New Hampshire 03104) is a pathologist interested in growing and photographing CP. He just published a good article in New England Wildflower Notes (Spring, 1974) on culture under lights.
 DAVID A. ROYCROFT (Biology Dept., Calasactius School, 167 Windsor Ave., Buffalo, N.Y. 14209).
 P.D. NORRIS (51 Conway Road, Hanworth, Middlesex, England).
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 PATRICIA WISOFF (936 Cambridge Place, Norfolk, Virginia 23508).
 JOHN SERGER (Dept. of Entomology, University of Manitoba, Winnipeg R3T 2N2 Canada).
 MRS. D. LIEHR (3774 1/2 39th Street, San Diego, California 92105).

NEWS AND VIEWS

We have received word of the first formal academic CP course taught this past fall at the University of Michigan through its adult education branch. The two-day, ten-hour course was co-instructed by LARRY MELLICHAMP and FRED CASE.

KATSU notes that another two CP postage stamps came out last year, 1973: (1) Nepenthes pervillei Bl. issued by Repoblika Malagasy (25 F); (2) Nepenthes sp. issued by Cambodia. These stamp pictures are not botanical but artistic.

BILL HANNA writes that he has now growing a small piece of a cold growing Nepenthes which one can grow outside in the open and does not need to be put in a hothouse for the winter. He begged a piece of this plant from his brother who grows it on the side verandah of his house. His plant is about twenty feet long and grows up the wall and then along the roof. He lives on the coast at the 33° south latitude in N.S.W. Australia. The Nepenthes plant has three different types of pitchers: tiny green ones about two inches long on the bottom, the other type looks like a picture of N. x goettingensis (N. mixta x N. dicksoniana) pitchers as seen in Exotica by A.B. Graf. Finally, the third type resemble the pitchers of Nepenthes rafflesiana as shown in the May, 1964 edition of Paul A. Zahl's article in National Geographic Magazine.

Newcastle, Australia has fairly mild winters when the coldest temperatures reach a low 40° F. The maximum summer temperatures are around 110° F. but the average is about 85°F. "My brother lives at a place called Kilaben Bay on the waterfront bordering Lake Macquarie. Here he grows that Nepenthes species on his side verandah which is shaded and hardly ever gets any direct sun at all. It is growing in a rather odd brew of things. Originally, it was growing in a pot of pure sphagnum mass and as it outgrew the pot, it was transferred to pure peat moss and now is potted in a mixture of peat moss and coarse sand. It is due for potting again and as far as I know, it is going into peat moss and sand. The potting medium was purely a matter of what was on hand at the time."

RAUL HERNANDEZ writes in to invite anyone in the San Francisco area to visit him and his collection. He works in the Conservatory in Golden Gate Park where he grows part of his collection. His working hours are Sunday through Thursday and he would appreciate it if members could come at lunchtime to discuss and view plants since this is his only free time. He is interested in expanding his collection and so be prepared to exchange plants when you arrive.

ZELIMIR K.T. SAHIN from the Netherlands is very interested in purchasing seed of all the carnivorous plants, especially Dionaea, Drosera, Sarracenia and Darlingtonia. If you can help him by securing large amounts of seed either now or in the future, he would like to hear from you. You may write to him at: Uiterweg 34, Aalsmeer 1210, The Netherlands.

As most of you know, CPN is sold by subscription and we prefer that all subscriptions arrive BEFORE the new volume year. We order a certain number of copies printed equal to the number of subscriptions received. Then we order a few extra copies for the stragglers. As we near the end of Volume III, the supply of those extra copies is nearly exhausted; in fact, by the time you read this they might all be gone. If you are spreading the word about CPN to your friends, they still could send in their subscription, but they must wait for Volume IV which is due to be published in March, 1975. So, please ask them to be patient and they will definitely start receiving their Volume IV issues next year.

JON CONANT writes in to ask for past issues of CPN. Our answer to his inquiry is that our supply is exhausted because of an unpredictable enthusiastic response to this newsletter. Our hope is that you will contact some of the other subscribers whose addresses appear at the end of this volume. Perhaps they would be willing to Xerox Volume I and II which number about 150 pages of reading material. Jon is also inquiring about a source for Lloyd's book. If anyone knows where to acquire copies of this 1942 book titled Carnivorous Plants, please write to us.

PATRICE A. MORROW of Canberra City, Australia writes that his main interest is in Nepenthes ecology. He did a month's field work on the genus in Sarawak two years ago and should probably be doing more work in the Cape York region of Australia in a month's time. In Canberra, he has been raising Nepenthes from seed and trying to get enough plants to do experiments on the allocation of nitrogen within the plant at different feeding rates. His main problem is that his seed took eighteen months to germinate, and if he is to continue his research, he will need many more plants and much faster germination. When seed ripens this January, he shall try suggestions from CPN and Leo Song and communicate the results if he has any great success.

On the question of why there seems to be more male flowering plants of Nepenthes than female plants in cultivation, Mr. Kusakabe relates Dr. Komiya's investigation of this problem on the Malay Peninsula. He found that there were more plants with male flowers than female. Nepenthes is largely anemophilic (wind pollinated) but some species have scented flowers so that they attract insects for pollination and therefore are entomophilic.

Because it is mostly a wind pollinated plant, more male flowers ensures successful seed set.

DAVE TAYLOR writes to inform us that he has started a carnivorous plant revolution in Great Britain. He carried this out by having a letter published in a weekly garden newspaper. The letter contained information about his plants and he also mentioned CPN. Ever since then, he has had scores of letters sent to him from all over the country. He has answered every letter and has given information on how they could acquire CPN. He now will look forward to seeing a few more English names in this newsletter.

BILL HANNA tells us that there is a nursery, McLeod Nursery, 325 McLeod Street, Cairns, Queensland 4870 Australia, which specializes in orchids. However, on his expeditions into the North Qld. Cape York Peninsula, he will pick up Nepenthes mirabilis forma Garrawaye (?) and others. Mr. J. Walker is the proprietor of the nursery and he will begin taking orders for a trip that he is planning to take next season. Bill thinks that he charges about \$12 for a plant. He already was advised to look out for Drosera species and if he comes across any, he will let Bill know. However, a recent letter from Mr. Walker indicates that he is in the process of moving his nursery and cannot see an open date in the immediate future for his trip. So, it might be a bit early to order plants now, but hopefully Bill will let us know when there is a good time.

STATISTICS

PART I (From World List of CP)

<u>GENERA</u>	<u>NO. OF SPECIES</u>	<u>NO. OF HYBRIDS</u>
Aldrovanda	1	0
Byblis	2	0
Cephalotus	1	0
Darlingtonia	1	0
Drosera	144	3
Drosophyllum	1	0
Dionaea	1	0
Genlisea	16	0
Heliamphora	6	0
Nepenthes	71	53
Pinguicula	64**	2
Polypompholyx*	2	0
-tenella (R. Br.) Lehm.		
-multifida (R.Br.)		
Sarracenia	12	30
Utricularia	164	0
	<u>486</u>	<u>88</u>

*Omitted from the World List of CP by oversight. Both species are found in Australia.

**Includes P. alga.

PART II

SUBSCRIBER MEMBERS (VOL. III)

United States	206	New Zealand	2
Japan	62	Netherlands	2
Australia	16	Belgium	1
England	8	Norway	1
Canada	4	Cyprus	1
Switzerland	4		
Germany	3	GRAND TOTAL	313
France	2		
South Africa	2		

CARL FORST send us information on where we may obtain a culture of microworms and micro-eels for feeding Aldrovanda and Utricularia cultures. They also can be used to feed any of the pitcher plants with good results. For 25¢ one can order a catalogue from:

Aqua Engineers
250 Cedar Street
Ortonville, Michigan 48462

DAVE LIEBL writes that he found Drosera linearis and Sarracenia purpurea growing in very close proximity to one another. The Drosera were in the open with their roots set in muddy soil perhaps about one-half inch above the water line of the lake. They would receive about full sunlight throughout 80-90% of the day, and there were no Drosera even in partial shade. The Sarracenia were perhaps an inch to two inches lower into the bog and received a similar amount of sunlight. He was not equipped to take pH readings but presumably the bogs are fairly acidic as are most Wisconsin bogs.

JOHN BOURGEOIS writes to us about Drosera binata "T" form which he is growing under Gro-lux lamps and noticed two different forms and leaf mutations. The first form was a short leaf with three small branches or prongs all having tentacles. The second form was a T-shaped leaf with an independent leaf growing out from the edge. The stalk had no tentacles but ended in another T-shaped structure that was tentacled. He would like to hear from others who noticed such deviant behavior in this plant species.

Again, along with CPN's policy to note all mutations and sports of CP, CARL FORST sent us a photograph of a Nepenthes gracilis plant which produced two pitchers at the end of one lamina. Both pitchers were normal in size and shape. Has anyone seen three pitchers to a lamina?

DAVE TAYLOR from England is enthusiastic about the interest in CP that he is stirring up in his plant conscious community. A large horticultural institute located near him indicated interest in starting a collection. He has informed us that the district of Norwood Green has an annual summer and autumn show run by its horticultural society. He plans to eventually exhibit some CP at the shows.

For rooting Nepenthes cuttings and germinating Nepenthes seed, it is highly desirable to apply bottom heat to the pot in order to achieve the fastest results. Faster rooting insures against loss of the plant material to fungus and bacterial infections which could take place during the long interval of time it takes these plants to root under ordinary conditions. It occurred to us that there are some very simple ways of applying bottom heat to your pots when it is necessary. First, those people who are using fluorescent fixtures have a ready-made heater on the top surface of the fixture. Usually one can find a place where the temperature is not too hot but just warm. A plastic bag must be placed over the cutting or seed pot to retain moisture. When you water every week or two, do it away from the fixture and allow to drain before replacing. Secondly, another type of warm temperature supply can be made from a sturdy cardboard box wrapped with plastic. Cut several holes in the top to insert your pots. A light bulb and socket can be inserted in a side hole. The lamp wattage depends on the size of the box. The desired temperature should be about 80° F. Water the plants away from this unit since water will break the light bulb.

For obvious reasons, we like to use the genus name rather than the common name when discussing or writing about a particular CP. In many conversations that we have had with CPN members, we noticed that there was some uncertainty about pronouncing the genus names and in fact, it was difficult at times to understand just what plant was being discussed. In order to alleviate this uncertainty, we have listed below the way the various genera may be pronounced according to Webster's unabridged dictionary. The syllable to be stressed is capitalized. We would remind everyone, however, that there is no official botanical pronunciation.

Aldrovanda	Aldrō-VAN-da	Genlisea	Gen-LI-cia
Byblis	BIB-les	Heliamphora	Hēlē-AM-fora
Cephalotus	Sefa-LO-des	Nepenthes	Ne-PEN-thēs
Darlingtonia	Darlin-TO-neā	Pinguicula	Pin-GWI-cula
Dionaea	DIO-nia	Polypompholyx	Poli-POM-fo-lix
Drosera	DRO-se-ra	Sarracenia	Sare-CEN-ia
Drosophyllum	Droso-FI-lem	Utricularia	Yu-trik-ye-LA-ria

ROBERT FOLKERTS sends the following: "Electronics has been my work as well as my passion for many years and I am intensely interested in exploring electrical activity in many of these plants. Especially interesting is Dionaea which at times is extra active electrically and seems to have an electronic language to accompany triggering of a trap. Regrettably I have not been keeping proper notation on these experiments because up to now things were in the curiosity stage. From this point on, however, I intend to keep notes as accurately as the degree of sophistication my equipment and capabilities will allow. Much work remains to be done in this and other areas of plant research with possible extra exploration into the new Kirilin photography.

"I am also attempting to shoot some "good" color and black and white photos of all aspects of carnivorous plants, including natural habitat wherever possible, and the unusual ways in which they obtain their food. I am moved by the beauty in some of these plants and would like to get results that could transfer this feeling to the viewer. Strict photo requirements dictate that terrarium settings be as natural looking as possible, and efforts are

being made on my part to make my growing containers as photo flexible as can be. Main attractions, however, are still the plants which make beautiful show pieces as well as sparking many a conversation. My photos are not quite up to my own standards as of yet, but I am enclosing a few for your enjoyment and possible use in the newsletter anyway."

CYRIL PERMUTT sent a note along with a portion of a magazine from England called Radio Times which advertises a film shown on TV last September. The film is called "The Tender Trap" and features many carnivorous plants and how they capture insects. It was made by Oxford Scientific Films, two OSF directors being Sean Morris and Peter Parks, who took great pains to take some remarkable close-up film of plants growing in the Botanical Gardens in Oxford where the superintendent, Ken Burras, is an expert in their cultivation. They used much time-lapse photography and special filters to minimize the heat from the lights to photograph Drosera tentacles closing inward on its prey. They also showed Dionaea and Utricularia capturing insects. Cyril watched this show on BBC and found it to be interesting, accurate, and beautifully photographed. He goes on to suggest that perhaps some American stations could be persuaded to show it. It would be well worth the effort.

JOE MAZRIMAS is still working with Byblis seeds: "Fire seems to be the key in unlocking the inhibition of germination for Byblis gigantea seed. After soaking the seed overnight in water, I sowed them on the surface of peat moss and sand mixed in a ratio of 1:2. Then I used a small Bunsen burner and scorched the surface with the hot flame until steam appeared. You can also use a butane lighter or pipe lighter with the same results. Several weeks later, 3-4 seedlings popped up much to my delight, and I carefully transplanted them to a sphagnum moss-perlite mixture where they are growing rapidly under the lights. The other species, Byblis liniflora, does not need this special seed treatment since they germinate rather well after several weeks on a moist peat. It is interesting that seeds of B. gigantea left on moist peat without this treatment failed to germinate even after two and one-half years. In its native area, it seems that the summer sun heats the white silica sand surface to broiling temperatures where the seed settles from the season before so that the fall rain initiates growth after some inhibitor is cooked out of it."

ADDITIONS TO WORLD LIST OF CP

These species should be added to your list of carnivorous plants in order to make the list complete and up-to-date.

<u>Pinguicula algida</u> (Malyshev)	USSR
<u>Nepenthes campanulata</u> (Kurata)	Sumatra
<u>Nepenthes rhombicaulis</u> (Kurata)	Sumatra
<u>Polypompholyx tenella</u> (R.Br.) Lehm.	Australia
<u>Polypompholyx multifida</u> (R.Br.) F.	Australia

SHORT NOTES

THOUGHTS ON THE ETHICS OF PLANT TRADING by The Co-Editors

Partly as a result of CPN and the seed and plant exchange, there has developed an unprecedented traffic in plant trading among CP enthusiasts. Increased communication and interest have all contributed. Most serious students of CP encourage plant trading for several reasons. First of all, herbarium and field studies are very important but certainly have obvious limits: one cannot truly approach knowing a plant until he studies its history, its condition and relationships in the field, and until he successfully grows it in culture. Secondly, many original field sites are physically or financially too difficult to visit or the plants are protected and so one must rely on obtaining samples of the living plants, with history, from another grower or someone close by the location. Thirdly, with extinction threatening many CP, some species may in the future only be found in private collections or botanical gardens and therefore we must learn their requirements under differing available conditions. Fourthly, rarer plants in culture should be spread out among other reliable growers. If disaster befalls one culture, there will be others from which plants may be obtained. Finally, commercial sources may not have the required species, or they may be prohibitively expensive, or perhaps they are not packaged and shipped promptly or properly. With these views in mind, the seed and plant exchange section was conceived within CPN and, as you know, is under the very able direction of Bob Ziemer.

Generally, exchanges are running well, but as might be expected, some rather irritating and important problems have developed and unfortunately these tend to sour the project to some degree for everyone because of a few abuses on the part of a very small number of people. The abusers are not all newcomers to carnivore botany or young people; one of the co-editors had a very difficult time getting a German botanical garden to properly reciprocate on a promised-and-agreed-beforehand trade agreement after he had sent valuable plants to them. Many problems

simply revolve around poor manners or ill timing. Some professional botanists are so beleaguered by requests for successfully grown plants that they destroy their excess material rather than acknowledge requests for it since it would take up too much time answering requests, allotting material, packaging and mailing.

We have therefore decided to suggest some ground rules that seem fair and reasonable to us. Since no one else has come forward to write this note, the rules suggested are obviously narrow in origin, and all commentary about additional ideas, modifications or deletions are welcomed and will be printed.

1. In most cases, use the seed and plant exchange as much as possible--it is free* to all CPN subscribers and entrance into the exchange simply requires a copy of your list of living plants whether or not you have anything to trade. Plants for trade from the list will be appropriately keyed on computer printout. It is not a good idea for individuals to write blanket letters of request to botanical gardens or known large growers.
2. When using the exchange computer list, be sure to write only those individuals who have indicated that they have specific plants for trade. If someone has listed, for example, Cephalotus follicularis in his collection but does not indicate that he has sufficient material for trading, it is best not to send requests except in exceptional instances where small amounts of material are needed for a reasonable or legitimate project.
3. In order to save wear and tear on the individual or garden willing to trade plants, it is best to have as few people write for trades as possible. Thus, if you live in an area with a relatively large number of CPN subscribers or CP enthusiasts, such as the L.A. group, it would probably be better to designate one or two members of that group to work out a trade, propagate the material, then share it with the group rather than each individual bombarding the potential source.
4. When writing for plants, be courteous, clear and concise and offer a trade where possible, no matter what you have to offer. Some sources will not require a trade per se, others will be exacting. You must respect the wishes of the potential source. If he feels he cannot trade with you, the matter should be considered closed for a time period.
5. When you do agree to trade, trade. Both co-editors and others we have talked to have had unpleasant experiences with sending out plants for trade and never receiving the exchange material. As a result, we have personally blacklisted such individuals and pass the word on them to others in personal letters. If you have promised a trade but a delay has come up, promptly write the other person, explain the delay fully, and give a date when you expect to send plants. Procrastination and unfulfilled promises will not only lead to your receiving a bad name among trading CP enthusiasts, but also may shut off disgusted important sources to those who seriously mean to complete their obligations.
6. When you have received some plants, write an acknowledgement to the sender as soon as possible, at least within two or three days. Briefly mention what was received, what date it was received, and what condition the material was in. Besides being good manners, the source will know that his valuable material is safe and that his methods of packing and shipping are satisfactory.
7. Do not become a nuisance or plant-hounder. When trade is refused, graciously accept this fact and watch the exchange lists for additional news. If a letter of trade request goes unanswered, it may mean that it was lost in the mail, or the source has nothing to trade and that no reply is therefore a negative reply. Everyone is entitled to be grumpy at times, and we do seem to have a few permanent grumps among our lot, but we would agree that an answer of some sort from the potential source is common courtesy. So, if your first letter goes unanswered, it is proper to write one more time after a reasonable period (usually four to six weeks--he may be ill or in the field), carefully explaining that the second letter is intended in case the first was lost. If there is still no reply, consider it a negative reply.

We believe that if these simple, largely common sense guidelines are followed, that plant trading will become more efficient and pleasant for all so that the important goals of such trades can be properly met.

* Volume III, Number 1 asks for a small fee of 50¢ to cover postage of the list, sent to Bob Ziemer.

A LATE SUMMER CP FORAY INTO MICHIGAN AND ONTARIO

by D.E. Schnell and R. Sivertsen

The main purpose of our trip in the last days of August, 1974, was to observe and photograph Drosera linearis as well as to search for the interesting hybrids between this species and D. rotundifolia. We had some locations for sites noted 10+ years previously in southeastern Michigan, particularly the marl bog areas from Brighton Lakes eastward to Pontiac. However, a search of the area disclosed marked acidification (pH readings of lakes, streams, ponds, and puddle waters--6.0-6.25) with considerable overgrowth by tall reeds and Typha over former seepage flats. In fact, as our search progressed that day, we soon learned that the presence of Typha, spotted easily from roads, was a good negative association. One area, Bridge Lake in Oakland Co., is extensively developed on one shore while the other--where many orchids and Droseras had been described as late as ten years previously-- was covered with dense vegetation into the water. Near Bridge Lake, we found locations around other springs, etc., that still had the open, marly appearance necessary to sustain D. linearis, but in each case the water was definitely acidic and only scattered D. rotundifolia was found.

The decrease of D. linearis in lower Michigan is pretty well documented. (C.E. Wood, Rhodora 57:105-130. 1955; L. Mellichamp, personal communication.) In fact, field botanists have actually watched good stands disappear in a matter of a few years, the change being most often correlated with acidification, floristic changes and particularly, rising water levels of lakes and ponds adjacent to marl seepage flats. Unusually wet years and impoundment contribute to the latter. Larry Mellichamp informs us that of several previously known good locations in southeastern Michigan passed on to him, none retain D. linearis, the closest remaining Michigan plants being found much farther north near Cheboygan on Lake Huron.

After disappointment in lower Michigan, we proceeded to the Bruce Peninsula in Ontario where the species had been seen by one of us (R.S.) in a rapidly declining bog the year previously, and where we would investigate another location* where the plants had been seen as recently as six years ago. We were amply rewarded at the latter location which is a typical white cedar-sedge, marl seepage flat of about four acres just a few hundred yards from the shore of Lake Huron. pH checks of the waters in this area disclosed neutrality (pH 7.0) and the water was highly buffered. There were many S. purpurea purpurea with the small, brightly colored, increased number of pitchers per crown associated with marl edaphic conditions (A.J. Mandossian, The Mich. Botanist 5:26-35, 1966). Typha was conspicuously absent.

The Droseras presented a most interesting situation. D. linearis was there by the hundreds, occurring mainly in the open marl flats area where there was often water. No D. linearis was found in shaded areas. Early winter bud formation was noted along with many ripe seed capsules. Scattered throughout the bog were numerous grassy and mossy hummocks a foot or more across and many D. linearis also grew around the lower margins of these more acidic islands.

Occurring higher up on the hummocks were numerous D. rotundifolia of the usual large northern bog form. Finally, on several hummocks of one sector of the bog near a partially shaded wooded margin were many plants that could be interpreted as D. anglica, or various degrees of hybridization between D. linearis, D. rotundifolia, and possible fertile F₁ hybrids ("D. anglica"). Most of these intermediate plants had sterile scapes but a few had full seed capsules. Microscopic examination of this seed revealed that it is identical to that of fertile D. anglica (Wynne, F.E. Bull. Tor. Bot. Club. 71:173, 1944). Leaf form varied from a typical, though large D. anglica appearance towards more linearity, and a few plants (that had they been in South Africa) looked very much like D. capensis. The intermediates were all growing on the tops of the hummocks or else on the sloping sides; never in the flat, wet marl areas.

D. linearis x D. rotundifolia, and the place of D. anglica is a complex interrelated problem. It has been proposed that D. anglica (Wood, 1955) is of amphiploid origin from the above hybrid. This concept is strongly supported by morphological, anatomic and karyologic evidence. D. linearis, D. rotundifolia and the sterile hybrid are all 2n=20, while D. anglica found in locations far distant from the above species, and fertile hybrids of the above species morphologically indistinguishable from D. anglica are 2n=40, thus strongly suggesting that allopolyploidy has occurred. An extreme interpretation of this data would be to declare all D. anglica as fertile hybrid, and indeed Wagner (W.H. Wagner, Jr., in V.H. Heywood [ed.], Modern Methods in Plant Taxonomy, Academic Press, New York, 1968. pp. 115, 132-133) suggests designating the plant as D. x anglica with sterile and fertile forms and not giving it specific status at all.

So the Droseras in this little marl bog have presented us with a real series of problems and we will be some time untangling the situation. There will undoubtedly be fertile and sterile hybrids, and possibly the capensis-like plant will prove to be either a backcross of fertile hybrid x D. linearis, or possibly even a tetra- or higher ploid of D. linearis.

After Ontario, we re-entered Michigan and could not leave without visiting a bog of the interesting S. purpurea purpurea f. heterophylla.^{*} This was a beautiful northern bog where the form was quite abundant and easily found even in late summer: the pale yellow-green scapes, sepals, bracts and expanded styles stood out above the grass in marked contrast to the red pigmented typical forms and presumed intermediates. The pitchers were similarly pale yellow-green, often with bright yellow margination of the hoods. Side-by-side plants made excellent comparison photos. Here is another important problem that needs work: how this form manages to retain integrity and is not swamped into the typical genome even though some interbreeding does apparently occur as suggested by the intermediates.

Our last stop was Wilderness State Park at the very northern tip of the lower peninsula where we were to observe Pinguicula vulgaris. One of us (D.S.) had seen the plants at the tip of Waugoshance Point exactly ten years previously and we were anxious to see how they had been doing. We were somewhat disappointed. Storms and rising water levels coincident with several unusually wet seasons in Michigan had so remolded the shoreline that the parking lot at the point had been moved back about 50 yards, the old pilings still visible out in the water! What was once a broad sand spit was now a smaller semi-island to which we waded and found the plants growing among rocks in shallow humus-sand with bedrock no more than an inch below the surface. A few other plants were found in the arc of shoreline immediately behind the island. These are particularly fine, large specimens and they were in early winter bud but with this season's leaves still present. This stand is clearly endangered and any further water rise will likely eliminate them from this location.

(*We cannot give out directions for these locations since the people from whom we obtained them would prefer they not be publicized. However, those who make serious inquiry to us will be given the names and addresses of the original informants to whom they may write directly to request any information. Those who do make such further inquiries should consider no reply as a negative reply in order not to work a hardship on these people with a great return letter burden.)

DROSERA FILIFORMIS RAF. IN FLORIDA

by R.K. Godfrey

Drosera filiformis is variously interpreted by authors to be identical with D. tracyi MacFarlane; or that the two are specifically distinct; or that they are varietally distinct. I lean strongly to the view that they are specifically distinct but have no great qualms about treating them as two varieties of D. filiformis. Some years ago I became acquainted with D. filiformis (or D. filiformis var. filiformis) on Cape Cod and in the New Jersey Pine Barrens. Later, in Florida, specially in the Florida Panhandle, I have "lived with" D. tracyi (or D. filiformis var. tracyi) and have not hitherto observed any plants which "rang my bell" for the Cape Cod or New Jersey Pine Barrens version. This past week, however, I nostalgically revisited a locality in Bay County in the Florida Panhandle, a sinkhole pond or lake, Merial Lake, where some years ago some colleagues and I discovered four then undescribed flowering plants: Rhexia salicifolia Kral and Bostick, Hypericum lissophloeus Adams, Xyris longisepala Kral and X. isoetifolia Kral. This time I was astonished and delighted to find the more northern version of Drosera, D. filiformis, there. I immediately reached Kral in Nashville by telephone and asked whether he had ever encountered the northern D. filiformis in Florida. His response, "Well, on one of my visits to the Bay County lakes I got a Drosera which appeared to me like the one I had previously seen in the New Jersey Pine Barrens. Not being especially interested in Drosera, though, I put it aside in my undetermined boxes and there it remains still, I think."

Inasmuch as there is the difference of interpretation as to the identity of these plants, ranges given in the manuals mean little. There may be prior records for Drosera filiformis for Florida. In any case, this records it definitely if my identification is correct. The citation: Wet sands, shores of Merial Lake, below high water mark; north of Vicksburg, Bay County, Florida; 10 October 1974, R. K. Godfrey 73947 (FSU).

NOTES ON AUSTRALIAN DROSERAS

by Steve Clemesha

Although Australia has over sixty species of Drosera (including some as yet undescribed), the great majority of the continent is not rich in number of species, as it is in only the southwest corner of Western Australia that an extraordinary number of species grows.

Tropical north Queensland with its contrasting very wet and semi-arid regions has only nine species. Though South Queensland and New South Wales have a well watered coast and highlands and considerable summer humidity, only eight species are found in the entire region and one of these has a very limited habitat within N.S.W. and this very close to the Victorian border. In the south Qld.-N.S.W. region, no species is endemic to the region except D. lovellae F.M. Bailey which appears to be a synonym of D. spatulata and therefore has not been included in the total of eight. The species within N.S.W. and south Queensland show with one exception (D. binata) no local specialization or evolution of distinct forms. They are widespread species most of which extend overseas and those that do not are widespread in other parts of Australia.

Victoria has nine species and the island state of Tasmania has eight. South Australia, the neighboring state to Western Australia, has ten though one of these has three forms.

One of the main groups of Droseras in Australia is the tuberous group. They grow in Western Australia where they grow through the cooler months and survive the summer by means of a tuber. They are totally unsatisfactory in cultivation. Numbers of plants always fail, the plants are hard to propagate as leaf cuttings do not strike, seed production is low and the seed are often hard to germinate. Only a single species of the W.A. tuberous group is found outside this region, that is D. stricticaulis (Diels) O.H.S. which extends to S.A. Plants from there are much smaller and the area they grow in is much more limited. D. peltata, an eastern species, has been reported from a single collection in W.A., but this seems improbable.

An interesting species which possibly is related to the tuberous group is D. hamiltonii Andrews. It is confined to swamps of the south coast of W.A. Here it never dries out and the plant appears to abandon the tuberous habit and become a fibrous rooted evergreen. Its rosette of leaves bears a similarity to those of the rosette forming tuberous species. Because of its loss of the tuberous habit, D. hamiltonii is very easy to cultivate. It can easily be propagated by leaf and root cuttings. It is not very full flowering and is uncommon in its native habitat. Flowers are only occasionally produced in cultivation.

Though only one tuberous species native to W.A. extends outside the state, there are four tuberous species that occur in southeastern Australia. They decline in numbers as one travels north and east and are best developed south where all the species occur and there are two forms of one, D. whittakeri Planch. This plant is found only in Victoria and S.A. The form found in Victoria and in the southeast of S.A. grows in large colonies and increases vegetatively by means of underground runners. Its rosettes are rather small and it is not very free flowering. In the hills near Adelaide two other forms are found. One of these, like the more easterly occurring form, flowers in the spring but its rosettes are larger and it flowers much more freely. It does not, however, increase vegetatively.

The other form is D. whittakeri var. pruefolia (Tepper) Black. This form flowers before the leaves appear in autumn. It has a very limited distribution and it is important that at least one of its habitats be preserved before the species is lost.

D. planchonii Hook. ex Planch. like D. whittakeri, has never been found in N.S.W. but it is more widespread and extends to Tasmania. Generally it is found scattered in sandy soils, often with D. auriculata and D. peltata.

The remaining two tuberous Drosera species do extend into N.S.W. They are very similar to each other and seem to involve different forms. The most reliable way of separating them is by examining the sepals. Those of D. peltata Smith are hairy whereas those of D. auriculata Buckh. are glabrous. These two plants grow in a wide variety of soils and habitats, but are still cultivation problems. D. auriculata extends from S.A. to Victoria, Tasmania and New Zealand. It also extends north through N.S.W. to southern Queensland. D. peltata has a similar distribution but does not extend as far as New Zealand. However, it does occur north to India, Malaysia, China and Japan. D. peltata var. gracilis is reported to be a softer, more slender plant found in Victoria and Tasmania. Some botanists consider it to be a separate species, but I never have seen it and cannot comment.

Another highly evolved group of Australian Droseras is found principally in W.A. This is the pygmy group. While a few species grow in swamps, most are found in regions that dry out in summer; that is, on the soil surface. Their long, fine roots can extend a foot or more to damper levels below. As the hot, dry summer approaches and flowering finishes, the leaves of

all but the swamp dwellers dry up, but a bud well protected by stipules survives, and these can only survive if the plant does not completely dry out. When the autumn rains come, the plants again begin to grow. Over winter they produce reproductive gemmae which are splashed out by rain onto the surrounding soil where they begin to grow. In spring flowering begins, some species having beautiful orange flowers.

With a few exceptions, the plants are hard to grow in eastern Australia where the summer rains cause problems. Since the plants cannot be allowed to dry out fully, they cannot be taken in out of the rain and have water withheld unless one can be sure excessive drying will not occur, and in the hot summer this is very difficult.

Though about twenty species of pygmy Drosera are found in W.A., only one of these is found in the other states; and as well, an annual species which has similarities to the group extends beyond W.A., too.

The eastern pygmy species is D. pygmaea C. It is a tiny plant which like the related D. occidentalis produces single flowered scapes. Until recently it was believed not to occur in W.A., but it has been found along the south coast of that region in a number of localities. Outside of these, it occurs in S.A., Vic., Tas., N.S.W., S. Qld, and New Zealand. Around Sydney it favors sandy regions where there is not much competition. Often plants of D. spathulata grow nearby though the latter extends into wetter habitats. D. pygmaea is easy to cultivate.

D. glanduligera Lehm. is an annual species with flowers similar to some of the orange flowered pygmy species but its leaves are a different shape and produce no gemmae. Its seeds germinate in autumn and plants grow through the winter, and the flowers set seed and die as their habitats dry out. This species is common in W.A. and extends to S.A., Vic., and N.S.W. In N.S.W., the only state where I have seen it growing, it occurs mainly among moss, etc. on nodes and in some instances becomes very wet and sodden over winter. Summer is very hot and dry. Within N.S.W. it is most common in southern inland areas but extends to the south coast where it is much less plentiful and seems to prefer habitats that do get very hot in the summer. This species is very hard to keep in cultivation, and I find seed germination poor.

D. binata Labill is probably the best known Australian Drosera because of its ease of cultivation. Unlike all the other species, it seems to be southeastern based. It extends from southern Qld. through N.S.W. and Vic. to Tasmania, S.A., and New Zealand. In Qld. and along the swamps of northern N.S.W., the form that exists there has much more heavily pigmented leaves than the others, and these are narrower and branch more freely. In one region, the flowers have a pink tinge, but in other regions they are white as is normal for this species. Plants of this form from cold winter regions of Qld. are deciduous, like many southern forms except those from milder habitats which are evergreen.

Around Sydney, a green form with most of its leaves double-branched is most common. It grows in wet soils, between rock crevices and along small stream banks. In a rather limited area of the Blue Mountains a third form exists. Its leaves divide only once. There appear to be forms intermediate between the last two, i.e., ones which produce occasional twice divided leaves.

D. arcturi Hook is a small species with a few erect narrow leaves. It is an alpine plant growing among other plants of its habitat above the treeline. It is difficult to cultivate in areas with short, mild winters like Sydney. It is found in N.S.W., Vic., Tasmania and New Zealand.

D. spathulata Labill in Australia is confined to the east coast. It extends south to Eastern Victoria. It grows in wet sandy places and its red rosettes are usually the first Drosera with which people become familiar. Usually the flowers are pink, but in some regions populations of white flowered plants occur, usually as isolated stands and not intermixed. D. spathulata is usually a perennial but in dry years plants die off and colonies are replaced by seedlings. This species extends to Japan and occurs in most countries between.

D. burmanni Vahl is similar to D. spathulata and like it is usually, but not always, a perennial. I have only seen it growing once in its native habitat and that was on a swampy flat with D. pygmaea and D. auriculata. It extends from about Sydney northward to Taiwan but is uncommon in the southernmost part of its range.

The remaining Australian species that occur outside southwest W.A. are tropical, and I have not seen any of them in their natural habitats.

D. adae F. Muell and D. schizandra Diels grow near creeks in fairly heavy shade. They have only been in cultivation a few years but already are becoming more common in collections.

D. prolifera C. T. White appears to be even less common than the two preceding species. It also grows in shaded habitats and so far has not been introduced into cultivation.

D. petiolaris R. Br. appears to be related to the pygmy group, but as far as records indicate at this stage, it does not produce reproductive gemmae. It grows in sunny habitats which become dry on the surface at least. It grows across northern Australia and in New Guinea.

D. indica Linn also grows across northern Australia and also around waterholes of inland regions such as central Australia. It is an annual species and often is locally plentiful. In Australia, it is a plant of the tropics. It extends to Africa, India and Japan.

D. banksii R. Br. is a slender, rather weak-looking plant with the habit of D. auriculata generally, but its roots are fibrous and no tuber is formed. Possibly it is an annual. It is found across northern Australia and there appears to be no record of an attempt to cultivate it.

SPECIAL NOTICES

FINAL RENEWAL NOTICE!

This is the last issue for those who have subscribed to one volume and have not yet renewed. Please use the renewal blank (and complete the poll) in the previous issue of CPN (No. 3). ALL RENEWALS MUST BE IN BY JANUARY 15, 1975. We cannot guarantee that you will receive Volume IV if you delay beyond that date.

ZELIMIR K. TVRTKOVIC SAHIN (Uiterweg 34, Aalsmeer 1210, The Netherlands) is looking for large quantities of seed and other material of all CP, labeled, so that he can distribute them in outlets in Europe, hoping to reach many people. Commercial arrangements might be worked out if mutual financial arrangements could be made. Various U.S. and other commercial sources of CP may be interested in contacting Mr. Sahin since this would ultimately involve bulk shipments of material to him rather than many individual little mailings all over Europe.

FRANK PETERSON (761 Hialeah Drive, Hialeah, Florida 33010) has a large number of Nepenthes khasiana plants for sale in 8, 10, and 12 inch pots, the prices being \$15.00, \$20.00, and \$25.00, respectively.

After the last mailing of CPN, the Postal Service returned CPN issues because it was unable to deliver them. So, at this time, Joe would like to remind everyone to give your COMPLETE address. Mail was returned for the following reasons:

- (1) You moved and forgot to give a forwarding address.
- (2) You forgot to write in Street, Drive, Way, or Circle on the end of the street name.
- (3) You forgot to give the apartment number.
- (4) You forgot to give the zip code.

If you have a friend who is complaining that he hasn't received his issues yet after a long wait, please have him write to Joe again and include the correct address so that he can enjoy reading CPN again.

While we are on this subject, Joe would appreciate getting only permanent addresses rather than a temporary one. Definition of a permanent address is living at one address for a period of three months or longer. Please do not send temporary addresses, especially those that are good for two to three weeks only since it confuses Joe's system of registration.

Here are some additional addresses of people and places that sell carnivorous plants. We urge you to write to them for details:

Jim Peterson, 7231 Kermore Lane #8, Stanton, California 90608 Retail only.
Sun Dew Environments, P.O. Box 503, Kenmore Station, Boston, Mass. 02215.

A change in address for Armstrong Associates:

Armstrong Associates, Inc., Box 94H, Kennebunk, Maine 04043

Insectivorous Plant Environments, 26381 Whitman Street, Hayward, California 94554 - sells Sarracenia, Darlingtonia, Pinguicula, Drosera, and Dionaea.

THE CPN SHOP

Occasionally, we offer selected reprinting of some CPN material as well as savings on commercially printed CP books, such as the recent Japanese group of books. Prices for CPN material are strictly at cost with postage and packing included (surface rates, some air rates cited). Commercial books are sold at a savings for the buyer but with a slight profit for CPN which will be used for extra projects and more quality photos.

WORLD LIST OF CARNIVOROUS PLANTS - An updated list with synonymy and native areas mentioned. While based broadly on Index Kewensis, many references and experts were consulted during the task of preparing this worldwide listing.

--50¢ postpaid surface, \$1.00 air overseas--

KEY TO NORTH AMERICAN UTRICULARIAS by Katsu Kondo - This is the first modern key to this complex group that can be used objectively and that deals in above the ground or above the water structures, mainly flower characters. All other keys suffer from incompleteness, gross errors, and dependence on rather subjective determinations. Illustrated, with additional commentary by Peter Taylor. --50¢ postpaid surface, \$1.00 air overseas--

CPN SUBSCRIBERS LIST - Updated to October, 1974, includes active subscribers and addresses. --50¢ postpaid surface, \$1.00 air overseas--

CARNIVOROUS PLANTS by Randy Schwartz - The latest commercially published book on the subject. List price is \$6.95, available to CPN subscribers at a savings through the efforts of Randy. Surface mail only, \$5.50 ppd. U.S., Canada; \$5.75 overseas. (ON THIS OFFER ONLY, PLEASE HAVE ALL ORDERS IN TO JOE MAZRIMAS BY FEBRUARY 15.)

To order all materials, send payment to JOE MAZRIMAS, 329 Helen Way, Livermore, California 94550, U.S.A. Remember, all book orders must be in by February 15.

RECENT LITERATURE

Bussy, J.: A locality of Drosera anglica Huds. on calcareous tufa with basic pH.

Bull. Mens. Soc. Linn. Lyon 43 (1): 8, 1974. IN FRENCH

A locality in France with a basic substrate was found to support the growth of D. anglica.

Ciobanu, L.R. and Tacina, F.L.: The ultrastructure of the digestive glands in Drosera capensis L. Rev. Roum. Biol. Ser. Bot. 18 (5): 249-253 1973 IN FRENCH

In young secretory cells of Drosera capensis, cellular organelles were found that have a high stage of development. This indicates that these cellular organelles are involved in the process of secretion. The Golgi apparatus and endoplasmic reticulum and mitochondria were the organelles studied.

Kondo, K., Kondo, M., and Bogner, J.: Two new sundew introductions for growers of carnivorous plants. American Horticulturist Vol. 53 (4): 16-19 1974

This is an introduction to cultivated Drosera adelae and D. dichrosepala with three fine pictures.

Kondrat'ev, G.K.: Pollen of new Aldrovanda species from the Eocene period in the Angara River basin. Bot. Zh. 58 (6): 878-879 1973 IN RUSSIAN

Spores and pollen of two new species, Aldrovanda kuprianoviae and unica were found in the Angara River basin in Russia and are from the Eocene period.

Kupriyanova, L.A.: Morphological studies of Drosera pollen. Bot. Zh. 58 (8): 1155-1157 1973 IN RUSSIAN

An electromicroscopic study of pollen morphology of D. rotundifolia and D. anglica established the proximal position of the apertures rarely found in pollen of angiosperms.

Kurata, S. and Toyoshima, M.: Philippine species of Nepenthes. Gardens Bulletin Singapore. 26 (1): 155-158, 1972.

Ten taxa of Nepenthes were reported from the Philippines. Among them one species and three hybrids were described as new. Nepenthes globamphora described as a new species is a synonym and should be clearly placed in N. bellii according to the rules of International Botanical Nomenclature.

Kurata, Shigeo: Nepenthes from Borneo, Singapore and Sumatra. Gardens Bull. 26 (II): 227-232. 1973.

This paper is a summary of the author's trip to Indonesia in which he describes thirteen species, two of these new: N. campanulata and N. rhombicaulis.

Moser, Don: Big thicket of Texas. National Geographic, October, 1974.

In this general regional article, the author mentions and pictures Sarracenia alata and also says there are three other genera in the area. (Ed. Note--probably Utricularia ssp., Pinguicula pumila, Drosera brevifolia and D. capillaris.)

Newman, G.H.: Cultivation and propagation of insectivorous plants. New England Wild Flower Notes, Spring, 1974. (New England Wild Flower Preservation Society, Inc., Hemenway Road, Framingham, Mass. 01701)

The author details his experiences with growing and propagating several U.S. species of CP under lights, including exact soil compositions and arrangements of terraria.

Schnell, D.E.: More about the sunshine pitchers. NYBG Garden Journal, 24 (5): 146-147, 1974.

This article complements the one by Kondo, Kondo and Bogner four issues previous (See CPN III: 18, 30, 1974) in the NYBG Garden Journal, and updates the information by relating the present author's experience with successfully propagating H. heterodoxa by seed obtained in culture. Four photos by the author accompany the article.

Schnell, D.E.: Venus' Flytrap. Plants Alive. 2:20-22, 1974.

A popular account in a magazine for greenhouse hobbyists.

Schwartz, Randall: Carnivorous Plants. Praeger Publishers, Inc., 111 Fourth Avenue, New York, New York 10003, 1974. 128 pages. \$6.95

This is the second U.S. book to appear on the market in several months about CP. (See Vol. III, No. 3, 1974) The author provides detailed instructions on how to grow, feed, and care for more than forty species of these plants ranging from Byblis to Utricularia. The book is full of many black and white, full page closeups of various pitchers, flowers and plants. A separate chapter discusses the myths and folklore surrounding the plants throughout history. Finally, in the last few pages in the book he lists the places where plants can be purchased and names and addresses where they can be viewed on display.

Tokes, Z.A., Woon, W.C., and Chambers, S.M.: Digestive enzyme secreted by the carnivorous plant Nepenthes macfarlanei. Planta 119: 39-46 (1974)

At least two protease are present in the secretion of the pitchers of Nepenthes macfarlanei, a major one with an estimated molecular weight 59000 and a minor one of 21000. The specificity of the major enzyme, nepenthesin, was broader than previously reported, and strikingly similar to that of pepsin. Lipase activity was also demonstrated, while no amylase activity was present.

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 2-212, YAMATE
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 NAKANO-KU, TOKYO 165
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 2-28-17, KOSUBE-CHO
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CARNIVOROUS PLANT NEWSLETTER

SPECIAL PROJECT SUPPLEMENT NO. 1 (1974)

WORLD CARNIVOROUS PLANT LIST

With this issue we begin a comprehensive check list of the carnivorous plants of the world. In addition to the preferred species name, the list will include geographic distribution notations and important synonyms. Early experience with the CPN seed and plant exchange was fraught with problems of nomenclature and synonymy. Seeking relief we turned to Index Kewensis and summarized all of its supplements to obtain a list of the "valid" species and applicable synonyms. This list was inadequate. Index Kewensis is a librarian's attempt to provide some order in the literature of plants by listing a source in which a plant name first appeared. There is no attempt by the authors of Index Kewensis to correct errors of the taxonomist or to referee legitimate argument. Using the compilation of Index Kewensis as a base point, Bob Ziemer and Joe Mazrimas began to search the literature for reasonably definitive treatments of CP genera. In some cases, there was a recent and comprehensive monograph, such as Casper's 1966 treatment of Pinguicula. Peter Taylor has done an admirable job on the extensive and complicated Utricularia. In other cases, such as with Drosera, no recent comprehensive work has been published. In these cases, we have combined a number of regional studies. In all cases, we will cite the literature and our other sources used to compile the check list for each genus.

There will still be inevitable errors and legitimate debate associated with such an undertaking. Indeed, comments and discussion are expected and invited. These check lists are by no means the final word in the taxonomy and nomenclature of CP, but we feel they fairly represent "the state of the art" in most cases. New literature appears regularly on cytologic and ecological studies with live specimens from the field rather than the classic reliance on dried and pressed herbarium specimens studies. Kondo's excellent work on the differentiation of Utricularia cornuta and U. juncea is a good example of this more perceptive and definitive approach. We believe discussion and debate are healthy and hope the check lists can be used as starting point in identifying and clarifying areas of taxonomic confusion. In the meantime, we believe these lists will be useful to our readers.

Some very small and/or as yet poorly understood genera such as Dionaea, Polypompholyx and Hellamphora are not included in the lists.

GENLISEA

Very little definitive work has been done on Genlisea St. Hil., a taxonomically difficult genus. Most herbarium specimens are poorly preserved due to the delicate nature of the plant, and furthermore herbaria are usually incomplete. Taylor has observed that many of the species are polymorphic, and this factor along with the wide distribution of the genus has led to too many described species. This check list is the result of Peter Taylor's published work from South America and Africa along with his current thoughts on the genus.

Taylor, P. Lentibulariaceae. New York Botanical Garden, Memoirs 17(1):202-228. 1967.
- - - Lentibulariaceae. Flore d'Afrique Central(Zaire-Rwanda-Burundi).
 Spermatophytes, Jardin Botanique National de Belgique, Bruxelles. 31 Aug 1972.
 62 p.
- - - Lentibulariaceae. Flora of Tropical East Africa. Royal Botanic Gardens, Kew.
 2 July 1973. 28 p.

(P. Taylor and Bob Ziemer)

G. AFRICANA (OLIVER) SSP. AFRICANA -- TRIP. AFRICA
 G. AFRICANA SSP. STAFFII -- W. AND C. AFRICA
 G. ANFRACIUSA (TUTIN) = G. FILIFORMIS
 G. ANGOLENSIS (GOOD) -- ANGOLA, ZAIRE
 G. AUREA (A. ST. HIL.) -- BRAZIL
 G. BILGHA (HENJ.) = G. VIOLACEA
 G. CYLINDRICA (SYLVEN) = G. VIOLACEA
 G. ESMERALDAE (STEYERM.) = G. PYGMAEA
 G. FILIFORMIS (A. ST. HIL.) -- BRAZIL, VENEZUELA, GUYANA, CUBA, COLOMBIA, BR. MINORAS
 G. GLABRA (P. TAYLOR) -- VENEZUELA
 G. GLANDULOSISSIMA (H. E. FRIES) -- ZAMBIA
 G. GUIANENSIS (N. E. BR.) -- GUYANA, VENEZUELA, BRAZIL
 G. HISPIDULA (STAFF) SSP. HISPIDULA -- TRIP. AND S. AFRICA
 G. HISPIDULA SSP. SURGLARRA -- E. AFRICA
 G. LUETZELBURGII (MIRL. EX LUETZELH.) NICHEN = G. GUIANENSIS
 G. LUTEO-VIRIDIS (WRIGHT APUD SAUV.) = G. FILIFORMIS

SARRACENIA

This genus was the subject of a recent thesis by Sidney McDaniel while at Florida State University. McDaniel's nomenclature was used as the base for species and natural hybrid names used in this list; Bell's work was used for the artificial hybrids. We have deviated from these authors in that we recognize S. rubra ssp. purpurea ssp. purpurea and S. purpurea ssp. venosa as useful designations. The listing of hybrids is perhaps more extensive than need be, but we note that a horticultural hybrid name may occasionally be used in the literature and the check list will thereby provide ready access to hybrid composition and synonymy. We prefer the use of the formula name to the horticultural name in order to eliminate confusion. However, we realize that the formula names become quite long for F2 and above hybrids and authors may prefer horticultural names for brevity. The use of an X before the subgeneric portion of the horticultural name has been maintained according to the literature.

Bell, C.R. A cytotaxonomic study of the Sarraceniaceae of North America. Jour. Mt. Soc. 65:137-166. 1949.

-- Natural hybrids of the genus Sarracenia. I. History, distribution and taxonomy. Jour. Mt. Soc. 68:55-80. 1952.

Bell, C.R. and Case, F.W. Natural hybrids of the genus Sarracenia. II. Current notes on distribution. Jour. Mt. Soc. 72:142-152. 1956.

McDaniel, S. The genus Sarracenia(Sarraceniaceae). Bull. Tall Timbers Res. Sta. No. 9. Sept 1971.

(Bob Ziemer)

S. X AHLESII (BELL ET CASE) = ALATA X RUBRA -- ALA, MISS
 S. ALATA (WOOD) -- ALA, MISS, LA, TEX
 S. ALATA X PSITTACINA -- ALA, MISS
 S. APEOLATA (MACFAR.) = ALATA X LEUCOPHYLLA -- ALA, MISS
 S. CAIESBAEL (ELLIOTT) = FLAVA X PURPUREA -- VA, NC, SC, GA, FLA, ALA
 S. CHELSONII (MASTERS) = PURPUREA X RUBRA -- NC, SC, GA, FLA, ALA
 S. X COURTII (MASTERS) = PSITTACINA X PURPUREA -- CA, FLA, ALA, MISS
 S. X DIESNERIANA (HEEKA) = COURTII X FLAVA -- HORT.
 S. DRUMMONDII (CROOK) = S. LEUCOPHYLLA
 S. X EXCELLS (NICHOLS.) = LEUCOPHYLLA X MINOR -- GA, FLA
 S. EXORNATA (S.G.) = ALATA X PURPUREA -- ALA, MISS
 S. FLAVA (L.) -- VA, NC, SC, GA, FLA, ALA
 S. FLAVA X PSITTACINA -- GA, FLA, ALA
 S. FORMOSA (WEITCH EX MASTERS) = MINOR X PSITTACINA -- GA, FLA
 S. X GILPINII (BELL ET CASE) = PSITTACINA X RUBRA -- GA, FLA, ALA, MISS
 S. X HARPERI (BELL) = FLAVA X MINOR -- NC, SC, GA, FLA
 S. ILLUSTRATA (NICHOLS.) = ALATA X CAIESBAEL -- HORT.
 S. X LASCHKEI (HEEKA) = COURTII X MOOREANA -- HORT.

G. MARGARETAE (HUTCHINSON) -- ZAMBIA, MADAGASCAR, TANZANIA
 G. MINOR (A. ST. HIL.) = G. AUREA
 G. NIGROCAULIS (STEYERM.) = G. PYGMAEA
 G. ORNATA (MART. EX HENJ.) = G. AUREA
 G. OXYCENTRUM (P. TAYLOR) = G. PYGMAEA
 G. PULCHELLA (TUTIN) = G. REPERTS
 G. PUSILLA (WARM.) = G. REPERTS
 G. PYGMAEA (A. ST. HIL.) -- BRAZIL, VENEZUELA, GUYANA, COLOMBIA, TRINIDAD
 G. RECURVA (ROSSER) = G. MARGARETAE
 G. REFLEXA (HENJ.) = G. VIOLACEA
 G. REPERTS (HENJ.) -- BRAZIL, VENEZUELA, GUYANA, PARAGUAY
 G. RHODAIMENSIS (N. E. BR.) -- VENEZUELA
 G. SANARIAPUANA (STEYERM.) -- VENEZUELA
 G. STAFFII (A. CHEVALIER) = G. AFRICANA SSP. STAFFII
 G. SUBGLABRA (STAFF) = G. HISPIDULA SSP. SURGLARRA
 G. SURVIRIDIS (HUTCHINSON) = G. AFRICANA SSP. AFRICANA
 G. VIOLACEA (ST. HIL.) -- BRAZIL

S. LEUCOPHYLLA (RAF.) -- GA, FLA, ALA, MISS
S. MELANORHODA (HORT. VEITCH) = CATESBAEI X PURPUREA --
 HORT.
S. MINOR (WALT.) -- NC, SC, GA, FLA
S. MITCHELLIANA (NICHOLS.) = LEUCOPHYLLA X PURPUREA --
 GA, FLA, ALA, MISS
S. MOOREANA (VEITCH) = FLAVA X LEUCOPHYLLA -- GA, FLA,
 ALA
S. OREOPHILA (KEARNEY) -- CA, ALA
S. X POPEI (MASTERS) = FLAVA X RUBRA -- NC, SC, GA, FLA,
 ALA
S. PSITTACINA (MICHX.) -- GA, FLA, ALA, MISS, LA
S. PURPUREA (L.) -- EASTERN NORTH AMERICA
S. PURPUREA F. HETEROPHYLLA (EATON) -- NEWFOUNDLAND,
 NOVA SCOTIA, MASS, NJ
S. PURPUREA SSP. PURPUREA (WHEPERRY) -- NORTHERN RANGE TO
 NJ
S. PURPUREA SSP. VENOSA (RAF.) -- SOUTHERN RANGE FROM NJ
S. X READII (BELL) = LEUCOPHYLLA X RUBRA -- GA, FLA,
 ALA, MISS

PINGUICULA

The genus Pinguicula L. has been extensively studied within the past ten years by S. Jost Casper of the Institut für Spezielle Botanik der Friederich-Schiller-Universität Jena. Dr. Casper has published a number of monographs and shorter regional papers on the genus Pinguicula from which we have compiled this check list. There are still a number of areas of controversy. For example, Casper separated P. macroceras from P. vulgaris as a distinct species, the former ranging from northern California through Alaska and to Japan, the latter from northern Europe through Siberia, northern Alaska, Canada and the north-eastern United States. The only interface is in northwestern Canada and Alaska. Other taxonomists prefer to combine the two into P. vulgaris.

A second area of dispute concerns the Mexican Pinguiculas. McVaugh and Mickel (1963) prefer to combine many of the species found in Mexico while Casper prefers to separate them. We feel Casper presents a good argument for his decisions and we have consistently followed his approach in this check list.

Casper, S.J. On Pinguicula macroceras link in North America. Rhodora 64:212-221. 1962.
 - - - - Revision der Gattung Pinguicula in Eurasien. Peddes Repertorium, Bd. 66,
 H. 1/2. pp. 148. 1962.
 - - - - "Systematisch massgebende" Merk, ale für die Einordnung der Lentibulariaceen
 in das System. Ost. Bot. Zeit. 110:108-131. 1963
 - - - - Gedanken zur Gliederung der Gattung Pinguicula L. Botanische Jahrbücher
 82(3):321-335. 1963
 - - - - Neue Pinguicula-Arten aus Mexico. Peddes Repertorium 67:11-16. 1963
 - - - - Once More: The orchid-flowered butterworts. Brittonia 18:19-28. 1966.
 - - - - Monographie der Gattung Pinguicula L. Bibliotheca Botanica. Heft 127/128.
 Vol. 31, pt. 2. pp. 209. 1966.
 McVaugh, R., Mickel, J.T. Notes on Pinguicula Sect. Orcheosanthus. Brittonia 15:134-140.
 1963.

(Bob Ziemer and J.A. Mazrimas)

- P. PRIMULIFLORA (WOOD ET GODFREY) -- ALA, GA, FLA, MISS
 P. PUMILA (MICHX.) -- TEX, LA, ALA, NC, GA, FLA, BAHAMAS
 P. PURPUREA (MILLD.) = P. ALPINA
 P. RAMOSA (MIYOSHI EX YATABE) -- JAPAN
 P. REICHENBACHIANA (SCHINDLER) = P. LONGIFOLIA SSP.
 REICHENBACHIANA
 P. REUTERI (GENTY) = P. GRANDIFLORA F. PALLIDA
 P. REUTERI (SCHINDLER) = P. GRANDIFLORA SSP. RUSSA
 P. ROSEI (WATSON) = P. MORANENSIS
 P. SCOPULORUM (T.S. BRANDEGEE) = P. LILACINA
 P. X SCULLYI (DRUCE) = GRANDIFLORA X VULGARIS --
 IRELAND, FRANCE
 P. SIBIRICA (VEST) --- NOMEN DUBIUM
 P. SODALIIUM (FOURN.) = P. MORANENSIS
- P. SPATHULATA (LEDEBOUR) --- NOMEN DUBIUM
 P. SUBAEQUALIS (STOKES) = P. LUSITANICA
 P. VALLISNERIIFOLIA (WEBB) -- SPAIN
 P. VALLISNERIIFOLIA LUS. BREVIFOLIA (CASPER) -- SPAIN
 P. VARIEGATA (TURCZ.) -- SIBERIA
 P. VILLOSA (L.) -- ALASKA, CANADA, SWEDEN, NORWAY,
 FINLAND, U.S.S.R.
 P. VILLOSA F. ALBIFLORA (FRÖDIN) -- N. BOREAL
 P. VILLOSA LUS. RAMOSA (CASPER) -- N. BOREAL
 P. VIOLACEA (MICHX.) = P. PUMILA
 P. VULGARIS (L.) -- EUROPE, SIBERIA, AMERICAN BOREAL
 P. VULGARIS F. ALBIDA ((BEHM) NEUMANN) -- N. BOREAL
 P. VULGARIS F. BICOLOR (NORDST. EX FRIES) NEUMANN) --
 N. BOREAL

NEPENTHES

In the preparation of this listing, we relied upon the early work of two great botanists, J. M. Macfarlane and B. H. Danser. This genus is especially complex to decipher taxonomically because of its polymorphous nature and the relatively few constant characters within the species. As a result, the listing bulges with synonyms which we tried our best to record for you. Hybrids present even a greater problem since much of the time, the same cross made on different occasions was given a different name, or names have been mixed and various back and secondary crosses not properly recorded. Here, we relied on various horticultural encyclopedias to give us the most consistent information. Finally, many of the Japanese books and journal papers yielded helpful clues.

Macfarlane, J.M. Nepentheaceae; in: A. Engler, Das Pflanzenreich, IV, III(Heft 36) 1908.
 -- -- -- -- -- ,Nepenthes; in: L.H. Bailey, The Standard Cyclopedia of Horticulture, IV,
 pp. 2122-2130. 1919.

Danser, B.H. The Nepenthaceae of the Netherlands Indies. Bull. Jard. Bot. Buitenz.
 Ser. III, Vol. IX. 1928.

(JA Mazrimas and Bob Ziemer)

- N. ALATA (BLANCO) -- PHILIPPINES
 N. ALBA (RIDL.) = N. GRACILLIMA
 N. ALBOLINEATA (BAIL.) = N. MIRABILIS
 N. ALBO-MARGINATA (LOBB EX LINDL.) -- MALAYSIA, SUMATRA, BORNEO
 N. ALICAE (BAIL.) = N. GRACILIS
 N. X AMESIANA (VEITCH.) = RAFFLESIANA X HOOKERIANA
 N. AMPULLARIA (JACK) -- MALAYA, NEW GUINEA, BORNEO,
 SUMATRA
 N. ANAMENSIS (MACFARLANE) -- INDUCHINA
 N. ANGUSTIFOLIA (MAST.) = N. GRACILIS
 N. ARMERUSTAE (BAIL.) = N. MIRABILIS
 N. X ATRO-SANGUINEA = (DISTILLATORIA X GRACILIS) X
 KHASIANA
 N. X BALFOURIANA = MIXTA X MASTERSIANA
 N. BECCARIANA (MACF.) = N. MIRABILIS
 N. BELLII -- PHILIPPINES
 N. BERNAYSII (BAIL.) = N. MIRABILIS
 N. BLANCOI (BL.) = N. ALATA
 N. BICALCARATA (HOOK.) -- BORNEO
 N. X BOISSIENSE (LECOUFLE) = GRACILIS X SUPERBA
 N. BONGSU (KORTH.) -- SUMATRA
 N. BOSCHIANA (KORTH.) -- BORNEO
 N. BRACHYCARPA (MERP.) = N. PHILIPPINENSIS
 N. BURBIDGEAE (HOOK. F. EX BURBIDGE) -- BORNEO
 N. BURKEII (MASTERS) -- PHILIPPINES
 N. CARUNCULATA (DANSER) -- SUMATRA
 N. CELEBICA (HOOK.) = N. MAXIMA
 N. X CHELSONI (VEITCH. EX MASTERS) = DOMINII X HOOKERIANA
 N. CHOLMONDELEYI (BAIL.) = N. MIRABILIS
 N. CINCIA (MAST.) -- BORNEO
 N. CLIPEATA (DANSER) -- BORNEO
 N. X COCCINEA = HOOKERIANA X MIRABILIS
 N. COPELANDII (MACF.) = N. ALATA
 N. X COURTII (VEITCH.) = GRACILIS X DOMINII
 N. CURTISII (MAST.) = N. MAXIMA
 N. X CYLINDRICA (VEITCH.) = DISTILLATORIA X VEITCHII
 N. DEANIANA (MACFARLANE) -- PHILIPPINES
 N. DECURRENS (MACFARLANE) -- BORNEO
 N. DENSIFLORA (DANSER) -- SUMATRA
 N. X DICKSONIANA (LINDSAY) = RAFFLESIANA X VEITCHII

- N. DISTILLATORIA (L.) -- CEYLON
N. X DUMINII (VEITCH, EX MASTERS) = RAFFLESIANA X GRACILIS
N. X DURMANNIANA = MIRABILIS X SEDENI
N. DUBIA (DANSE) -- SUMATRA
N. X DYERIANA = MIXTA X DICKSONIANA
N. ECHINOSTOMA (HOOK.) = N. MIRABILIS
N. X EDINENSIS (LINDSAY) = RAFFLESIANA X CHELSONI
N. EDWARDSIANA (LOW EX HOOK.) -- BORNEO
N. EPHIPPIATA (DANSE) -- BORNEO
N. EUSTACHYS (MIG.) = N. ALATA
N. X EXCELSIOR (TAPLIN) = RAFFLESIANA X HOOKERIANA
N. FALLAX (BECK.) = N. STENOPHYLLA
N. X FORMOSA = CHELSONI X DISTILLATORIA
N. FUSCA (DANSE) -- BORNEO
N. GARRAWAYAE (BAIL.) = N. MIRABILIS
N. GEOFRAYI (LECOMTE) -- INDOCHINA
N. GLOBAMPHORA -- PHILIPPINES
N. GRACILIFLORA (ELM.) = N. ALATA
N. GRACILIS (KORTH.) -- BORNEO, MALAYSIA, SUMATRA, CELEBES
N. GRACILLIMA (RIDLEY) -- MALAYSIA
N. GYMNAMPHORA (MIG.) -- SUMATRA, BORNEO, JAVA
N. HARRYANA (BURR.) = N. VILLOSA
N. HEMSLEYANA (MACF.) = N. RAFFLESIANA
N. X HENRYANA (NICHOLSON) = SEDENI X HOOKERIANA
N. X HIBBERDII (WILL.) = HOOKERIANA X SEDENI
N. HIRUTA (HOOK.) -- BORNEO
N. HIRPIDA (BECK.) = N. HIRUTA
N. X HOOKERAE (BECK) = RAFFLESIANA X MIRABILIS
N. X HOOKERIANA (LOW) = RAFFLESIANA X AMPULLARIA -- BORNEO, SUMATRA, MALAYSIA
N. X HYBRIDA (VEITCH, EX MASTERS) = KHASIANA X GRACILIS
N. INERMIS (DANSE) -- SUMATRA
N. X INTERMEDIA (HURT, EX VEITCH.) = GRACILIS X RAFFLESIANA
N. INSIGNIS (DANSE) -- NEW GUINEA
N. JARDINET (BAIL.) = N. MIRABILIS
N. JUNGHURNII (RIDL.) = SANGUINEA X SINGALANA
N. KAMPOTIANA (LECOMTE) -- INDOCHINA
N. KENNEDYANA (F. MUELL.) = N. MIRABILIS
N. KHASIANA (HOOK.) -- ASSAM, INDIA
N. KLOSSII (RIDLEY) -- NEW GUINEA
N. LAEVIS (LINDL.) = N. GRACILIS
N. LANATA (MAST.) = N. VEITCHII
N. X LAWRENCIANA = MIRABILIS X HOOKERIANA
N. LEPTOCHILA (DANSE) -- BORNEO
N. LODDIGESII (BART.) = N. HOOKERIANA
N. LOWII (HOOK.) -- BORNEO
N. MACFARLANEII (HEMSL.) -- MALAYSIA
N. MADAGASCARIENSIS (POIR.) -- MADAGASCAR
N. X MASTERSIANA = SANGUINEA X KHASIANA
N. MAXIMA (REINH.) -- CELEBES, BORNEO, NEW GUINEA
N. MELAMPORA (BL.) = N. GYMNAMPHORA
N. MERRILLIANA (MACFARLANE) -- PHILIPPINES
N. MIRABILIS (DRUCE) -- WIDESPREAD DISTRIBUTION
N. X MIXTA (VEITCH.) = NORTHIANA X MAXIMA
N. X MIZUHO = RAFFLESIANA X DYERIANA
N. MOLLIS (DANSE) -- BORNEO
N. MONTROUZIERII (DUB.) = N. VIEILLARDI
N. MOOREI (BAIL.) = N. MIRABILIS
N. X MORGANIANA = MIRABILIS X HOOKERIANA
N. MULLIENSIS (HOTT) -- BORNEO
N. NAGUYA = MIXTA X THURELII
N. NEGLECTA (MACFARLANE) -- BORNEO
N. NEO-GUINEENSIS (MACFARLANE) -- NEW GUINEA
N. NORTHIANA (HOOK.) -- BORNEO
N. ORLANCEOLATA (RIDLEY) -- NEW GUINEA
N. X OUTRAMIANA = SEDENI X HOOKERIANA
N. PANICULATA (DANSE) -- NEW GUINEA
N. PAPUANA (DANSE) -- NEW GUINEA
N. X PARADISAE (HECK) = MIRABILIS X HOOKERIANA (TAPLIN)
N. PASCUENSIS (BAIL.) = N. MIRABILIS
N. PECTINATA (DANSE) -- SUMATRA
N. PERVILLEI -- SEYCHELLES
N. PETIOLATA (DANSE) -- PHILIPPINES
N. PHILIPPINENSIS (MACFARLANE) -- PHILIPPINES
N. PHYLLAMPHORA (STAPF.) = N. ALATA
N. PILOSA (DANSE) -- BORNEO
N. X PRINCEPS = MIXTA X DYERIANA
N. PUMILA (GRIFF.) = N. SANGUINEA
N. RAMISPINA (RIDL.) = N. GRACILLIMA
N. X RATCLIFFIANA = MIRABILIS X HOOKERIANA (COURT)
N. RAFFLESIANA (JACK) -- MALAYSIA, BORNEO, SUMATRA
N. RAJAH (HOOK.) -- BORNEO
N. X R. B. PRING = CHELSONI X DUMINII
N. REINHARDTIANA (MIG.) -- MALAYSIA, SUMATRA, BORNEO
N. X ROBUSTA = MIRABILIS X HOOKERIANA
N. ROMANAE (BAIL.) = N. MIRABILIS
N. X RUBRO-MACULATA = GRACILIS X KHASIANA X VEITCHII
N. X RUFESCENS = DISTILLATORIA X GRACILIS X RAFFLESIANA
N. SANGUINEA (LINDL.) -- MALAYA
N. X SEDENI (MAST.) = GRACILIS X KHASIANA
N. SINGALANA -- SUMATRA
N. SMILEYI (HEMSL.) = N. MIRABILIS
N. SPATHULATA (DANSE) -- SUMATRA
N. SPECTABILIS (DANSE) -- SUMATRA
N. SPURIA (BECK.) = N. NORTHIANA
N. X ST. LOUIS = CHELSONI X DUMINII
N. STENOPHYLLA (MAST.) -- BORNEO
N. X SUBERBA = SEDENI X HOOKERIANA
N. SURIGAUENSIS (ELM.) = N. MERRILLIANA
N. TENTACULATA (HOOK.) -- BORNEO, CELEBES
N. TEYSMANNIANA (MIG.) = N. ALBO-MARGINATA
N. THORELII (LECOMTE) -- CAMBODIA
N. X TIVEYI = MAXIMA X VEITCHII
N. TOBAICA (DANSE) -- SUMATRA
N. TOMORIANA (DANSE) -- CELEBES
N. TREUBIANA (WARR.) -- NEW GUINEA, SUMATRA
N. TRICHOCARPA (MIG.) -- SUMATRA, BORNEO, MALAYSIA
N. TRUNCATA (MACFARLANE) -- PHILIPPINES
N. X TSUJIMUTO = MASTERSIANA X WHIGLEYANA
N. TUBULOSA (MACF.) = N. MIRABILIS
N. VEITCHII (HOOK.) -- BORNEO
N. VENTRICOSA (BLANCO) -- PHILIPPINES
N. VIEILLARDI (HOOK.) -- NEW CALEDONIA
N. VILLOSA (HOOK.) -- BORNEO
N. X WILLIAMSII = SEDENI X HOOKERIANA
N. X WITTEI = MAXIMA X STENOPHYLLA
N. X WHIGLEYANA (VEITCH, EX MASTERS) = MIRABILIS X HOOKERIANA
N. ZEYLANICA (RAFIN.) = N. DISTILLATORIA

The genus *Utricularia* L. has been the subject of exhaustive morphologic studies by eminent botanists for many years. As a result, a large number of species have been described in the literature. Until recently, objective taxonomic work on the genus has been wanting, primarily because of the inadequacy of the material available for study. Most of the specimens available in herbaria are dried and in varying states of preservation and completeness.

This list was initially compiled from Index Kewensis and Peter Taylor's published work, including of course errors in both, and subsequently revised by Taylor to express his current views on the genus. However, it must be borne in mind that whereas Taylor has now virtually completed his studies of the African and New World species, further studies on the Asian and Australian species will inevitably entail some revision of the list. Some of the opinions now expressed regarding African and American species are at variance with Taylor's published work, representing yet unpublished revisions. In a few cases, due to the absence of type material and inadequate original descriptions, it is not possible to state that a name represents a good species or a synonym. In the list, these are indicated by a query (?) sign. In some difficult Asian groups not yet sufficiently studied, names are referred to as aggregate species followed by a 'sensu lato' (i.e. in the broad sense) implying that it may eventually be possible to recognize these entities as distinct in some rank or other.

(P. Taylor and B. Ziemer)

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The genus *Utricularia* L. (*Lentibulariaceae*) in Africa (south of the Sahara) and Madagascar.

Kew Bull. 18(1):1-248. 1964

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Utricularia viscosa Spruce ex Oliver. *Lentibulariaceae*. Tabule 3631. Hooker's Icones Pantarum

Vol. VII, Part II. 3 p. 1967

Lentibulariaceae. Studies in the flora of Thailand. Dansk Botanisk Arkiv 23(4):527-532. 1968.

A new species of *Utricularia* (*Lentibulariaceae*) from Rwanda and Burundi and notes on several

species of *Utricularia* occurring in the area of the Flore du Congo, du Rwanda et du Burundi.

Bull. Jard. Bot. Nat. Belg. Bull. Nat. Plantentuin Belg. 41:269-272. 1971.

Lentibulariaceae. Flore d'Afrique Centrale (Zaire-Rwanda-Burundi). Spermatophytes, Jard. Bot.

Nat. Belg., Bruxelles. 31 Aug 1972. 62 p.

Lentibulariaceae. Flora of tropical East Africa. Royal Botanic Gardens, Kew. 2 Jul 1973. 28 p.

U. ABRANS = U. WELWITSCHII

U. ADENANTHA = U. AMETHYSTINA SENSU LATO = U. HIRTELLA

U. ADRESSA (SALZM. EX ST. HIL. ET GIR.) -- BR. HONDURAS,

VENEZUELA, GUYANA, BRAZIL, TRINIDAD

U. AFFINIS = U. ULIGINOSA SENSU LATO

U. AFROMONTANA = U. LIVIDA

U. ALATA = (PROB.) U. BIFIDA

U. ALBA (HOFFMG. EX LINK) = U. OBTUSA

U. ALBIFLORA (R. BR.) -- AUSTRALIA

U. ALBINA = U. CAERULEA

U. ALBO-COERULEA = U. GRAMINIFOLIA SENSU LATO

U. ALPINA (JACQUIN) -- S. AND C. AMERICA, WEST INDIES

U. ALUTACEA = U. AMETHYSTINA

U. AMAZONASANA = U. HYDROCARPA

U. AMETHYSTINA (ST. HIL. ET GIR.) -- FLORIDA TO BRAZIL

U. AMOENA = U. MYRIOCISTA

U. ANDICOLA = U. LIVIDA

U. ANDONGENSIS (HIERN) -- GUINEE TO ZAMBIA AND ANGOLA

U. ANGOLENSIS = U. SUBULATA

U. ANGULOSA = U. JUNCIEA

U. ANGUSTIFOLIA = U. HISPIDA

U. ANOMALA = U. OBTUSA

U. ANTHROPOPHORA = U. STRIATULA

U. APHYLLA = U. OBTUSA

U. APPENDICULATA (E. A. BRUCE) -- CAMEROUN TO MOZAMBIQUE

U. AFRICA

U. ARCUTATA = U. GRAMINIFOLIA SENSU LATO

U. ARENARIA (A. DC.) -- SENEGAL TO ETHIOPIA TO SW. AND

S. AFRICA, MADAGASCAR, INDIA

U. ARENICOLA = U. NANA

U. ARROJADENSIS NOMEN = U. LONGIFOLIA

U. AUREA (LOUR.) -- INDIA TO AUSTRALIA, JAPAN

U. AUREOLA = U. ADPRESSA

U. AUREOLIMBA = U. ADPRESSA

U. AUREOMACULATA (STEYERM.) -- VENEZUELA

U. AUSTRALIS (R. BR.) -- TROP. AND S. AFRICA, EUROPE, TEMP.

ASIA TO JAPAN, AUSTRALIA, TASMANIA, NEW ZEALAND

U. AYACUCHAE = U. CUCULLATA

U. BALDWINII = U. HISPIDA

U. BANGWEOLENSIS = U. REFLEXA VAR. REFLEXA

U. BAULENSIS (A. CHEV.) -- TROP. AFRICA, MADAGASCAR,

INDIA, PHILIPPINES, AUSTRALIA

U. BARBATA = U. CHRYSANTHA

U. BAUERII = U. CAERULEA

U. BAUMII = U. SPIRALIS VAR. SPIRALIS

U. BENJAMINIANA (OLIVER) -- GUYANA, SURINAME, TROP.

AFRICA, MADAGASCAR, TRINIDAD

U. BICOLOR = U. AMETHYSTINA

U. BIFIDA (L.) -- INDIA TO AUSTRALIA, JAPAN

U. BIFIDOCALCAR = U. OBTUSA

U. BIFLORA (LAM.) -- E. U.S.A.

- U. BILOBA (R. BR.) -- INDOCHINA, THAILAND, MALAY, AUSTRALIA, NEW GUINEA
 U. BIPARTITA = U. BIFLORA
 U. BISQUAMATA = U. CAPENSIS
 U. BLANCHETII (A. DC.) -- BRAZIL
 U. BOLIVARANA = U. AMETHYSTINA
 U. BOSMINIFERA (OSTENFELD) -- THAILAND
 U. BOTECUDORUM = U. FOLIOSA
 U. BRACHIATA (WIGHT) -- INDIA
 U. BRACHYACERAS = U. CAPENSIS
 U. BRACTEATA (GOOD) -- ANGOLA, ZAMBIA, ZAIRE
 U. BRADEI = U. SUBULATA
 U. BRAMADENSIS NOMEN = U. LONGIFOLIA
 U. BREMII (HEER) -- EUROPE
 U. BREVICORNIS = U. OCHRULEUCA
 U. BREVILABRIS = U. MINUTISSIMA
 U. BREVISCAPA (WRIGHT EX GRISEB.) -- CUBA, GUYANA, BRAZIL
 U. BRYOPHILA = U. MANNII
 U. BUTANENSIS NOMEN = U. FOLIOSA
 U. CAERULEA (L.) -- INDIA TO AUSTRALIA, JAPAN
 U. CAERULEA VAR. STRICTICAULIS = U. STRICTICAULIS ((KOENIG) STAFF EX GAMBLE)
 U. CALLIPHYSA (STAFF) = U. MINUTISSIMA
 U. CALUMPITENSIS = U. AUREA
 U. CALYCIFIDA (BENJ.) -- GUYANA, VENEZUELA, SURINAME
 U. CAMPBELLIANA (OLIVER) -- VENEZUELA, GUYANA
 U. CANACORUM (PELLEGR.) -- NEW CALEDONIA
 U. CAPENSIS (SPRENG.) -- MADAGASCAR, S. AFRICA
 U. CAPILLACEA (WILLD.) = ?
 U. CAPILLARIS = U. SUBULATA
 U. CAPILLIFLORA (F. MUELL.) -- AUSTRALIA
 U. CAVALERII = U. CAERULEA
 U. CEARANA (STEYERM.) -- BRAZIL
 U. CERATOPHYLLA (MICHX.) = U. INFLATA
 U. CERATOPHYLLOIDES = (PROB.) U. BILOBA
 U. CERVICORNUTA = U. BENJAMINIANA
 U. CHAROIDEA = U. REFLEXA VAR. REFLEXA
 U. CHIRIBIQUETENSIS (A. FERNANDEZ) -- COLOMBIA, VENEZUELA
 U. CHRYSANTHA (R. BR.) -- AUSTRALIA, NEW GUINEA
 U. CLANDESTINA = U. GEMINISCAPA
 U. CLEISTOGAMA = U. SUBULATA
 U. COCCINEA = U. HYDROCARPA
 U. COLENSOI = (PROB.) U. LATERIFLORA
 U. COLORATA = U. LAXA
 U. COMPRESSA -- ?
 U. CONCINNA = U. JAMESONIANA
 U. CONFERTA = U. EXOLETA
 U. CONGESTA = U. SIMULANS
 U. CONNELLII = U. PUBESCENS
 U. CORNUTA (MICHX.) -- N. AMERICA, BAHAMA, CUBA
 U. CRENATA (VAHL) = U. OBUSA
 U. CUCULLATA (ST. HIL. ET GIR.) -- S. AMERICA
 U. CUSPIDATA = U. CALYCIPIDA
 U. CUTLERI = U. VISCOSA
 U. CYANEA (R. BR.) = U. ULIGINOSA
 U. CYMBANTHA (OLIVER) -- ZAIRE, MUZAMBIQUE, ZAMBIA, BOTSWANA, ANGOLA, S. AFRICA, MADAGASCAR
 U. DAMAZIOI = U. AMETHYSTINA
 U. DAWSONI = U. AMETHYSTINA
 U. DEIGHTONII = U. PUBESCENS
 U. DELICATA = U. CAPENSIS
 U. DELICATULA (CHEESM.) = (PROB.) U. LATERIFLORA
 U. DELPHINOIDES (THUREL EX PELLEGR.) -- INDOCHINA, THAILAND
 U. DENTICULATA = U. LIVIDA
 U. DICHOTOMA (LARILL.) -- AUSTRALIA
 U. DIMORPHANTHA (MAKINO) -- JAPAN
 U. DIPLOGLOSSA = U. REFLEXA VAR. REFLEXA
 U. DISSECTIFOLIA NOMEN = U. FLACCIDA
 U. DREGEI = U. LIVIDA
 U. DURIA -- ?
 U. DUNSTANI (F. E. LLOYD) -- AUSTRALIA
 U. DUSENII = U. NEPHROPHYLLA
 U. ECKURNEA = U. LIVIDA
 U. ECKLONII = U. CAPENSIS
 U. ELEPHAS = U. CUCULLATA
 U. ELEVATA = U. LIVIDA
 U. ELMERI = U. HETEROSEPALA
 U. EMARGINATA = U. OBUSA
 U. ENDRESII (REICHB.) -- C. AMERICA
 U. ENGLERI = U. LIVIDA
 U. EQUISEICHAULIS = U. GRAMINIFOLIA SENSU LATO
 U. ERECTIFLORA (ST. HIL. ET GIR.) -- BR. HONDURAS, GUYANA, VENEZUELA, BRAZIL, NICARAGUA, COLOMBIA
 U. EVRARDII (PELLEGR.) -- INDOCHINA
 U. EXIGUA NOMEN = U. SUBULATA
 U. EXILIS = U. ARENARIA
 U. EXOLETA (R. BR.) -- AFRICA TO AUSTRALIA, JAPAN, SPAIN, PORTUGAL
 U. FALCATA = U. SPIRALIS VAR. TORTILIS
 U. FASCICULATA (ROXB.) = U. AUREA
 U. FERNALDIANA = U. PUBESCENS
 U. FIBRUSA (WALT.) -- E. U.S.A.
 U. FILIFURMIS = U. SUBULATA
 U. FIMBRIATA (KUNTH) -- COLOMBIA, VENEZUELA
 U. FIRMULA (WELW. EX OLIVER) -- TROP. AND SUBTROP. AFRICA, MADAGASCAR
 U. FLACCIDA (A. DC.) -- BRAZIL, PARAGUAY, COLOMBIA, VENEZUELA, ARGENTINA
 U. FLEXUOSA = U. AUREA
 U. FLORIDANA (NASH) -- FLORIDA, GEORGIA, N. AND S. CAROLINA
 U. FLUITANS = U. AUREA
 U. FOCKEANA = U. HYDROCARPA
 U. FOLIOSA (L.) -- FLORIDA TO ARGENTINA, TROP. AFRICA, MADAGASCAR, GALAPAGOS ISLANDS
 U. FONTANA = U. TRICOLOR
 U. FORGETIANA = U. LONGIFOLIA
 U. FURNICATA (LE CONTE) = U. HIFLORA
 U. FOVEOLATA = (PROB.) U. ULIGINOSA
 U. FULVA (F. MUELL.) -- AUSTRALIA
 U. FURCATA (PERS.) = U. OBUSA
 U. FURCELLATA = (PROB.) U. STRIATULA
 U. FUSIFORMIS = U. TRICOLOR
 U. GALLUPOVINCIALIS = U. AUSTRALIS
 U. GAYANA = U. OBUSA

U. GEMINIOBA (BENJ.) -- BRAZIL
 U. GEMINISCAPA (BENJ.) -- NE. U.S.A.
 U. GENLISEUIDES = U. HIRTELLA
 U. GENTREYI = U. LIVIDA
 U. GEOFFRAYI (PELEGR.) -- INDOCHINA, THAILAND
 U. GIBBA (L.) -- U.S.A.
 U. GIBBSIAE = U. SCANDENS SSP. SCANDENS
 U. GILFILLI = U. HENJAMINIANA
 U. GLAZIOVIANA NOMEN = U. NEOTTIOIDES
 U. GLOBULARIIFOLIA = U. TRICOLOR
 U. GLOECKII = U. HISPIDA
 U. GUEBELII NOMEN = U. PURPUREO-CAERULEA
 U. GUMEZII = U. TRICOLOR
 U. GRAMINIFOLIA (VAHL) -- INDIA TO NEW GUINEA
 U. GRANDIVISCULOSA = U. REFLEXA VAR. REFLEXA
 U. GRANITICOLA = U. PUBESCENS
 U. GRIFFITHII = U. ULIGINOSA
 U. GUIANENSIS (SPLITG. EX DE VRIES) = U. FOLIOSA
 U. GUYANENSIS (A. DC.) -- TRINIDAD, BR. HONDURAS, GUYANA
 U. GYRANS = U. SPIRALIS VAR. TORTILIS
 U. HAMILTONI (F. E. LLOYD) -- AUSTRALIA
 U. HARLANDI (OLIVER) = U. STRIATULA
 U. HETEROSEPALA (BENJ.) -- PHILIPPINES
 U. HERZOGII = U. NEOTTIOIDES
 U. HETEROCHROMA (STEYERM.) -- VENEZUELA
 U. HIANS = U. PREHENSILIS
 U. HIRTA (KLEIN EX LINK) -- INDIA, THAILAND, INDOCHINA, AUSTRALIA
 U. HIRTELLA (ST. HIL.) -- C. AND S. AMERICA
 U. HISPIDA (LAM.) -- BR. HONDURAS TO N. BRAZIL, TRINIDAD
 U. HOEHNEI = U. WARMINGII
 U. HOLTZEI (F. MUELL.) -- AUSTRALIA
 U. HOUKERI (LEHM.) -- AUSTRALIA
 U. HUMBERTIANA = U. LIVIDA
 U. HUMBOLDTII (R.H. SCHUMBURGK) -- VENEZUELA, MT. RORAIMA
 U. HUMILIS = U. LIVIDA
 U. HUMILIS (VAHL) = U. BIFIDA
 U. HYDROCARPA (VAHL) -- CUBA TO BRAZIL
 U. HYDROCOTYLOIDES = U. PUBESCENS
 U. IBARENSIS = U. LIVIDA
 U. IMERTENSIS = U. REFLEXA VAR. REFLEXA
 U. INCERTA = U. AUSTRALIS
 U. INCISA ((A. RICH.) ALAIN) -- CUBA
 U. INFLATA (WALT.) -- E. N. AMERICA
 U. INFLEXA (FORSK.) -- TRUP. AFRICA, MADAGASCAR, INDIA
 U. INTEGRAL (LE CONTE) = U. BIFLORA
 U. INTERMEDIA (HAYNE) -- EUROPE, ASIA, N. AMERICA
 U. INVOLVENS (RIDL.) -- MALAYA
 U. JAMESONIANA (OLIVER) -- ECUADOR, GUYANA, VENEZUELA, COLOMBIA, ANTILLES, PERU, COSTA RICA, PANAMA
 U. JANKAE = U. AUSTRALIS
 U. JANTHAE = U. RENIFORMIS
 U. JAPONICA = U. AUSTRALIS
 U. JAQUATIBENSIS NOMEN = U. LONGIFOLIA
 U. JUNCEA (VAHL) -- E. U.S.A., WEST INDIES, BR. HONDURAS, TRINIDAD, N. BRAZIL, COLOMBIA, VENEZUELA, GUYANA

U. KAIEIEURENSIS = U. AMETHYSTINA
 U. KALMALDENSIS = U. REFLEXA VAR. REFLEXA
 U. KAMIESKII (F. MUELL.) -- AUSTRALIA
 U. KERRII = U. CAERULEA
 U. KIMBERLEYENSIS (GARDNER) -- AUSTRALIA
 U. KIRKII = U. ARENARIA
 U. KUHLMANNI = U. TRICHOPHYLLA
 U. KUMADENSIS (OLIVER) -- HIMALAYA
 U. LACINIATA (ST. HIL. ET GIR.) -- BRAZIL
 U. LAGRENSIS = U. BREVISCAPA
 U. LASINCAULIS (F. MUELL.) -- AUSTRALIA
 U. LATERIFLORA (R. BR.) -- AUSTRALIA
 U. LAWSUNI = U. BILORA
 U. LAXA (ST. HIL. ET GIR.) -- ARGENTINA, PARAGUAY, BRAZIL
 U. LEHMANNI = U. CAPENSIS
 U. LEPTOPLECTRA (F. MUELL.) -- AUSTRALIA
 U. LEPTORHYNCHA (O. SCHWARZ) -- AUSTRALIA
 U. LILACINA (GRIFF.) = (PROH.) U. ULIGINOSA
 U. LILLIPUT = U. MINUTISSIMA
 U. LIMOSA (R. BR.) -- AUSTRALIA
 U. LINARIODES = U. WELWITSCHII
 U. LINDMANII = U. AMETHYSTINA
 U. LINGULATA = U. PREHENSILIS
 U. X LIITORALIS = ? U. MINOR X U. INTERMEDIA? = U. OCHROLEUCA
 U. LIVIDA (E. MEY.) -- ETHIOPIA TO CAPE PROVINCE, MADAGASCAR, MEXICO
 U. LLOYDII (MERL) -- S. AND C. AMERICA
 U. LOBATA = U. LIVIDA
 U. LONGECALCARATA = U. LIVIDA
 U. LONGECILIATA (A. DC.) -- SURINAME, GUYANA, VENEZUELA, COLOMBIA, N. BRAZIL
 U. LONGIFOLIA (GARDN.) -- BRAZIL
 U. LUETZELBURGII NOMEN = SPECIES TO BE DESCRIBED BY TAYLOR
 U. LUNDII = U. PRAELONGA
 U. MACERRIMA = U. HISPIDA
 U. MACRORHIZA (LE CONTE) -- TEMP. N. AMERICA, TEMP. E. ASIA
 U. MACRORHYNCHA = U. BIFLORA
 U. MADAGASCARIENSIS = U. LIVIDA
 U. MAGNAVESICA = U. REFLEXA VAR. REFLEXA
 U. MAGNIFICA = U. MYRTICISTA
 U. MAGUIHEI = U. CALYCIFIDA
 U. MAIRII = (PROH.) U. AUSTRALIS
 U. MAJOR = U. AUSTRALIS
 U. MALMEANA = U. CUCULLATA
 U. MANNII (OLIVER) -- HAMEUDA HIGHLANDS, CAMEROON MT., GULF OF GUINEA
 U. MARCELLIANA NOMEN = U. SUBULATA
 U. MAURUYAE = U. LIVIDA
 U. MAXIMA = U. RENIFORMIS
 U. MENZIESII (R. BR.) -- W. AUSTRALIA
 U. MEYERI (PILGER) -- BRAZIL
 U. MICRANTHA = (PROH.) U. ADPRESSA
 U. MICROCALYX (P. TAYLOR) -- TRUP. AFRICA
 U. MICROCARPA = U. PUSILLA
 U. MICROPETALA (SM.) -- W. TRUP. AFRICA
 U. MINIMA = U. OLIVACEA

- U. MINOR (L.) -- EUROPE, ASIA, N. AMERICA
 U. MINUTISSIMA (VAHL) -- INDIA TO BORNEO, AUSTRALIA, JAPAN, NEW GUINEA
 U. MIXTA = U. FOLIOSA
 U. MODESTA = U. AMETHYSTINA
 U. MONANTHA -- ?
 U. MONANTHOS (HOOK. F.) -- AUSTRALIA, TASMANIA, NEW ZEALAND
 U. MONOPHYLLA = U. ARENARIA
 U. MONTANA = U. ALPINA
 U. MOREI (F. E. LLOYD) = (PROB.) U. DICHOTOMA
 U. MUELLERI (KAM.) -- N. AUSTRALIA, NEW GUINEA
 U. MULTICAULIS (OLIVER) -- CHINA, HIMALAYA
 U. MULTISPINOSA = U. MINOR
 U. MUSCOSA = U. CALYCIFIDA
 U. MYRIOICISTA (ST. HIL. ET GIR.) -- S. AMERICA
 U. NAGURAI = U. EXOLETA
 U. NANA (ST. HIL. ET GIR.) -- BRAZIL, GUYANA, SURINAME, VENEZUELA
 U. NAVICULATA (P. TAYLOR) -- BRAZIL, VENEZUELA
 U. NEGLECTA = U. AUSTRALIS
 U. NELUMBIIFOLIA (GARDN.) -- BRAZIL
 U. NEOTIIODES (ST. HIL. ET GIR.) -- BRAZIL, COLOMBIA, VENEZUELA, BOLIVIA
 U. NEPALENSIS = (PROB.) U. MINOR OR U. BREMII
 U. NEROPHYLLA (BENJ.) -- BRAZIL
 U. NERVOSA = U. SUBULATA
 U. NIGRESCENS (SYLVEN) -- BRAZIL
 U. NIGRICALUS = U. MINUTISSIMA
 U. NIPPONICA = U. MINUTISSIMA
 U. NIVEA = U. CAERULEA
 U. NOVAE-ZELANDIAE (HOOK. F.) -- NEW ZEALAND
 U. OBSOLETA NOME = U. SUBULATA
 U. OBTUSA (SW.) -- WEST INDIES, S. AMERICA, TROP. AFRICA
 U. OBTUSILOBA = U. CAERULEA
 U. OCCIDENTALIS = U. OCHROLEUCA
 U. OCHROLEUCA (R. HARTM.) -- EUROPE, NW. AMERICA
 U. ODONTOSEPALA (STAPP) -- MALAWI, ZAMBIA, ZAIRE
 U. ODONTOSPERMA = U. LIVIDA
 U. ODORATA (PELLEGR.) -- INDOCHINA
 U. OGMOSPERMA = U. RETICULATA
 U. OLIGOCISTA = U. SURULATA
 U. OLIGOSPERMA = U. FOLIOSA
 U. OLIVACEA (WRIGHT EX GRISER.) -- E. U.S.A., CUBA, VENEZUELA, GUYANA, BRAZIL, SURINAME
 U. OLIVERANA (STEYERM.) -- VENEZUELA, AMAZONAS, COLOMBIA
 U. OLIVERI = U. INFLEXA
 U. OPHIRENSIS = U. CAERULEA
 U. ORBICULATA = U. STRIATULA
 U. ORINOCENSIS = U. SIMULANS
 U. OSTENII = U. TRIDENTATA
 U. PACHYCERAS = U. SINGERIANA
 U. PALLENS = U. OBTUSA
 U. PAPILLOSA = U. PUBESCENS
 U. PARADOXA = U. SPIRALIS VAR. SPIRALIS
 U. PARKERI = U. CAPENSIS
 U. PARKERIANA = U. OBTUSA
 U. PAUCIFLORA = U. EXOLETA
 U. PAUCIFOLIA = U. CAERULEA
 U. PECKII = U. GUYANENSIS
 U. PECTINATA = U. LONGECILIATA
 U. PELTATA = U. PUBESCENS
 U. PELTATIFOLIA = U. PUBESCENS
 U. PENTADACTYLA (P. TAYLOR) -- ETHIOPIA TO MALAWI AND RHODESIA
 U. PERPUSILLA = U. SUBULATA
 U. PHILETAS = U. STRIATULA
 U. PICTA = U. PRAELONGA
 U. PIERREI (PELLEGR.) -- INDOCHINA
 U. PILIFERA = U. REFLEXA VAR. REFLEXA
 U. PLATENSIS (SPEG.) -- ARGENTINA, URAGUAY
 U. PLATYPTERA = U. REFLEXA VAR. REFLEXA
 U. POEGUINII = U. SPIRALIS VAR. POEGUINII
 U. PODADENA (P. TAYLOR) -- S. NYASALAND, NW. MOZAMBIQUE
 U. POLYGALOIDES (EDGEW.) = (PROB.) U. GRAMINIFOLIA
 U. POLYSCHISTA = U. PRAELONGA
 U. PORPHYROPHYLLA = U. INCISA
 U. PRAELONGA (ST. HIL.) -- BRAZIL
 U. PREHENSILIS (E. MEY.) -- ETHIOPIA TO RHODESIA AND ANGOLA, S. AFRICA, MADAGASCAR
 U. PROTUSA (HOOK. F.) -- NEW ZEALAND
 U. PTEROCALYCINA (U. SCHWARZ) -- AUSTRALIA
 U. PTEROSPERMA (EDGEW.) = U. EXOLETA
 U. PUBERULA = U. PUBESCENS
 U. PUBESCENS (SM.) -- GUYANA, VENEZUELA, COLOMBIA, BRAZIL, TROP. AFRICA, INDIA
 U. PULCHERRIMA (SYLVEN) -- TRINIDAD, BRAZIL
 U. PUMILA (HENJ. NON WALT.) = U. SUBULATA
 U. PUMILA (WALT.) = (PROB.) U. BIFLORA
 U. PUNCTATA (WALL. EX A. DC.) -- INDIA, BUPMA, THAILAND, BORNEO
 U. PUNCTIFOLIA = U. AMETHYSTINA
 U. PURPUREA (WALT.) -- N. AMERICA, CUBA, BR. HONDURAS
 U. PURPUREO-CAERULEA (ST. HIL.) -- BRAZIL
 U. PUSILLA (VAHL) -- C. AND S. AMERICA, WEST INDIES
 U. PYGMAEA (R. BR.) -- AUSTRALIA
 U. QUADRICARINATA = U. PREHENSILIS
 U. GUELCHII (N.E. BRONN) -- VENEZUELA, GUYANA
 U. RACEMOSA = U. CAERULEA
 U. RADIATA (SMALL) -- N. AMERICA
 U. RAMOSA = U. BIFIDA
 U. RECLINATA = U. AUREA
 U. RECURVA = U. BIFIDA
 U. REFLEXA (OLIVER) -- SENEGAL TO SW. AND S. AFRICA, MADAGASCAR
 U. REGNELLII = U. PUBESCENS
 U. REHMANNII = U. CAPENSIS
 U. RENDLEI = U. SURULATA
 U. RENIFORMIS (ST. HIL.) -- BRAZIL
 U. RESUPINATA (GREENE) -- E. CANADA AND E. U.S.A. TO BR. HONDURAS, VENEZUELA, BRAZIL
 U. RETICULATA (SM.) -- INDIA, CEYLON
 U. RICCIODES = U. EXOLETA

U. SUBSIMILIS = U. NOVAE-ZELANDIAE
 U. SUBULATA (L.) -- NOVA SCOTIA TO ARGENTINA, TROP. AFRICA,
 MADAGASCAR, SIAM, BURNEO, PORTUGAL
 U. SUMATRANA = U. EXOLETA
 U. TAIKANKOENSIS = U. STRIATULA
 U. TENERRIMA = U. RAULEENSIS
 U. TENUICAILIS = U. AUSTRALIS
 U. TENUIFOLIA = U. ORTUSA
 U. TENUIS = U. ORTUSA
 U. TENUISCAPA = U. SUBULATA
 U. TENUISSIMA (TUTIN) -- TRINIDAD, VENEZUELA, GUYANA,
 COLOMBIA, N. BRAZIL
 U. TEPUIANA = U. AMETHYSTINA
 U. TERNATA = U. TRIDENTATA
 U. TETRALOBA (P. TAYLOR) -- W. AFRICA
 U. THOMASII = U. PUBESCENS
 U. TINGUENSIS NOMEN = U. ORTUSA
 U. TORTILIS = U. SPIRALIS VAR. TORTILIS
 U. TRANSUGOSA = U. LIVIDA
 U. TRIBRACTEATA = U. ARENARIA
 U. TRICHOPHYLLA (SPRUCE EX OLIVER) -- BRAZIL, VENEZUELA,
 GUYANA
 U. TRICHOSCHIZA = U. STELLARIS
 U. TRICOLOR (ST. HIL.) -- BRAZIL, PARAGUAY, COLOMBIA,
 VENEZUELA
 U. TRICRENATA = U. ORTUSA
 U. TRIDENTATA (SYLVEN) -- S. BRAZIL, URUGUAY, ARGENTINA
 U. TRILOBA (BENJ.) -- S. AMERICA
 U. TRILOBA (GOOD) = U. SUBULATA
 U. TRINERVIA = U. AMETHYSTINA
 U. TRIPHYLLA = U. GEMINILLOBA
 U. TROUPINII (P. TAYLOR) -- TROP. AFRICA
 U. TUBULATA (F. MUELL.) -- AUSTRALIA
 U. TURUMIGUIRENSIS = U. AMETHYSTINA
 U. ULIGINOSA (VAHL) -- INDIA TO AUSTRALIA
 U. UNIFOLIA (RUIZ ET PAVON) -- S. AND C. AMERICA
 U. VAGA = U. HYDROCARPA
 U. VELASCOENSIS = U. AMETHYSTINA
 U. VENEZUELANA = U. PUBESCENS
 U. VERAPAZENSIS = U. JAMESONIANA
 U. VERTICILLATA (BENJ.) = U. BILOBA
 U. VILLOSLA = U. BENJAMINIANA
 U. VIOLACEA (R. BR.) -- AUSTRALIA
 U. VIRGATULA = U. JUNCIA
 U. VISCOSA (SPRUCE EX OLIVER) -- TRINIDAD, VENEZUELA,
 GUYANA, BRAZIL, BR. HONDURAS
 U. VITELLINA (RIDL.) -- MALAYA
 U. VOLUBILIS (R. BR.) -- AUSTRALIA
 U. VULCANICA = (PROB.) U. AUSTRALIS
 U. VULGARIS (L.) -- N. TEMP. REGION INC. EUROPE, N. AFRICA,
 TEMP. ASIA
 U. WALLICHTIANA = U. SCANDENS SSP. SCANDENS
 U. WARMINGII (KAM.) -- S. AMERICA
 U. WELWITSCHII (OLIVER) -- KATANGA, RWANDA, AND BURUNDI
 TO ANGOLA AND S. AFRICA, MADAGASCAR
 U. WILLIAMSII = U. AMETHYSTINA
 U. YAKUSINENSIS = U. ULIGINOSA

U. RIGIDA (BENJ.) -- W. TROP. AFRICA
 U. ROBINSII = U. FIBROSA (E. DESCR.)
 U. ROGERSIANA = U. PUNCTATA
 U. RORAIMENSIS = U. AMETHYSTINA
 U. ROSEA = U. CAERULEA
 U. ROSULATA = U. STRIATULA
 U. ROTUNDFOLIA NOMEN = U. TRICOLOR
 U. RUBRA = U. TRIDENTATA
 U. RUBRICAILIS = U. GUYANENSIS
 U. SACCATA (LE CONTE) = U. PURPUREA
 U. SACCATA (MERL EX LUETZELB.) NOMEN = U. SUBULATA
 U. SACCIFORMIS (BENJ.) = U. AUSTRALIS
 U. SALWINENSIS (HAND.-MAZZ.) -- CHINA
 U. SALZMANNI = U. HYDROCARPA
 U. SANDERSONI (OLIVER) -- S. AFRICA
 U. SANDWITZII (P. TAYLOR) -- GUYANA, SURINAME, VENEZUELA
 U. SANGUINEA = U. LIVIDA
 U. SAUDADENSIS NOMEN = U. GEMINILLOBA
 U. SCANDENS (BENJ.) -- TROP. AFRICA, MADAGASCAR, TROP.
 ASIA, AUSTRALIA
 U. SCHIMPERI = U. JAMESONIANA
 U. SCHINZII = U. CAPENSIS
 U. SCHULTESII (FERNANDEZ PEREZ) -- COLOMBIA
 U. SCHWEINFURTHII = U. SCANDENS SSP. SCHWEINFURTHII
 U. SCIAPHILA = U. PUBESCENS
 U. SCLEROCARPA = U. JUNCIA
 U. SECUNDA = U. ORTUSA
 U. SELLOI -- ?
 U. SEMATOPHORA = U. LIVIDA
 U. SIAKUJIIENSIS = U. AUSTRALIS
 U. SIAMENSIS = U. MINUTISSIMA
 U. SIMPLEX (R. BR.) -- AUSTRALIA
 U. SIMPLEX (WRIGHT APUD SAUV.) = U. JUNCIA
 U. SIMULANS (PILGER) -- FLORIDA TO BRAZIL, TROP. AFRICA
 U. SINGERIANA (F. MUELL.) -- AUSTRALIA
 U. SINUATA = U. AMETHYSTINA
 U. SONTENPENSIS = U. CAERULEA
 U. SPARTEA = U. LIVIDA
 U. SPATULIFOLIA = U. AMETHYSTINA
 U. SPICATA = U. ERECTIFLORA
 U. SPIRALIS (SM.) -- TROP. AFRICA
 U. SPIRANDRA = U. ORTUSA
 U. SPRINGELII = U. CAPENSIS
 U. SPRUCEANA = U. RESUPINATA
 U. SQUAMOSA = U. GRAMINIFOLIA SENSU LATO
 U. STANFIELDII (P. TAYLOR) -- W. AFRICA
 U. STELLARIS (L. F.) -- TROP. AND S. AFRICA, MADAGASCAR,
 TROP. ASIA, AUSTRALIA
 U. STEYERMARKII (P. TAYLOR) -- VENEZUELA
 U. STOLONIFERA -- ?
 U. STRIATULA (SM.) -- TROP. AFRICA, INDIA TO NEW GUINEA
 U. STRICTA = U. JUNCIA
 U. STRICTICAILIS (KOEHNIG) STAPF EX GAMBLE) -- INDIA
 U. SUBPILATA = U. PUBESCENS
 U. SUBRECTA = U. GRAMINIFOLIA SENSU LATO

One of the major stumbling blocks in producing this checklist was the lack of modern, worldwide systematic review of the taxon relative to revision of numerous synonyms in the literature. For example, the southern extension of the range for *Drosera capillaris* and intermedia from the United States into Brazil is still disputed by some taxonomists resulting in annoying confusion that vexes the amateur and professional botanist alike. As a result, we had to rely on regional flora manuals and rather ancient treatises for our conceptions of some of the species described, and in so doing we likely excluded recently described species that may be valid. Our readers can help rectify the situation by informing us of any new partial or total treatments of the genus that we may have overlooked. Many of the sources we searched are not included in the following list of references, only those used being listed.

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- D. ACAULIS (L. F.) -- S. AFRICA
- D. ADELAE (F. MUELL.) -- AUSTRALIA
- D. AFFINIS (MELW. EX OLIVER) -- TROPICAL AFRICA
- D. ALBA (PHILL.) -- S. AFRICA
- D. ALDROVANDA (F. MUELL.) = ?
- D. ALICIAE (HAMEI) -- S. AFRICA
- D. ANDERSONIANA (FITZG. EX EWART, ET WHITE) -- AUSTRALIA
- D. ANDROSACEA (DIELS) -- AUSTRALIA
- D. ANGLICA (HUDS.) -- EUROPE, N. AMERICAN BOREAL, JAPAN
- D. ANGUSTIFOLIA (F. MUELL.) = D. INDICA
- D. ANNUA (REED) = D. BREVIFOLIA
- D. ARCTURIA (HOOK.) -- AUSTRALIA, NEW ZEALAND
- D. ARENICOLA (STEYERMARK) -- VENEZUELA
- D. ASCENDENS (PLANCH.) -- BRAZIL
- D. ATRA (COL.) = D. ARCTURI
- D. AURICULATA (BACKH. EX PLANCH.) -- AUSTRALIA, NEW ZEALAND
- D. BANKSII (R. BR. EX DC.) -- AUSTRALIA
- D. BEQUAERTII (TATON) -- C. AFRICA
- D. BINATA (LABILL.) -- AUSTRALIA, NEW ZEALAND
- D. BREVIFOLIA (PURSH) -- N. AMERICAN BOREAL
- D. BULBIGENA (MORRISON) -- AUSTRALIA
- D. BULBOSA (HOOK.) -- AUSTRALIA
- D. BULBOSA VAR. MAJOR (DIELS)
- D. BURKEANA (PLANCH.) -- S. AFRICA
- D. BURMANNI (VAHL.) -- ASIA, TROPICAL AUSTRALIA
- D. BURMANNI VAR. DIETRICHIANA (REICH8.)
- D. CALEDONICA (VIEILL. EX DIELS) -- NEW CALEDONIA
- D. CALYCINA (PLANCH.) -- W. AUSTRALIA
- D. CAPENSIS (L.) -- S. AFRICA
- D. CAPILLARIS (POIR.) -- N. AND C. AMERICA, COLOMBIA
- BRAZIL, GUIANA, VENEZUELA
- D. CAYENNENSIS (SAGOT EX DIELS) -- GUIANA, BRAZIL
- D. CENDEENSIS (TAMAYO ET CROIZAT) -- VENEZUELA
- D. CHIAPENSIS (MATUDA) -- MEXICO
- D. CHRYSOLEPIS (TAUB.) -- BRAZIL
- D. CIRCINERVA (COL.) = D. AURICULATA
- D. CISTIFLORA (L.) -- S. AFRICA
- D. COLLINSIAE (BROWN EX BURTT DAVY) -- S. AFRICA
- HYBRID? (D. BURKEANA X MADAGASCARIENSIS) ?
- D. COLOMBIANA (FERNANDEZ-PEREZ) -- COLOMBIA
- D. COMMUNIS (ST. HIL.) -- BRAZIL, COLOMBIA
- D. COMPACTA (EXELL. ET LAUNDON) -- ANGOLA
- D. CONGOLANA (TATON) -- C. AFRICA
- D. CORSICA (MAIRE) -- CORSICA
- D. CUNEIFOLIA (L. EX JACKSON) -- S. AFRICA
- D. CUNNINGHAMII (WALP.) = D. BINATA
- D. CURVIPES (PLANCH.) = D. MADAGASCARIENSIS
- D. CURVISCAPA (SALT.) = D. ALICIAE

D. DICHOTOMA (SM.) = D. BINATA
 D. DICHROSEPALA (TURCZ.) -- AUSTRALIA
 D. DIELSIANA (EXELL ET LAUNDON) -- S. AFRICA
 D. DIETRICHIANA (REICHB.) = D. BURMANI VAR. DIETRICHIANA
 D. DRUMMONDII (LEHM.) -- AUSTRALIA
 D. ELONGATA (EXELL ET LAUNDON) -- ANGOLA
 D. ERYTHROHIZA (LINDL.) -- AUSTRALIA
 D. ERYTHROHIZA VAR. IMBECILIA (DIELS)
 D. FERRUGINEA (LARRANAGA) -- URUGUAY
 D. FILICULAE (BENTH.) -- W. AUSTRALIA

 D. FILIFORMIS F. FILIFORMIS (RAFIN.) -- N. AMERICAN BUREAL
 D. FILIFORMIS F. TRACYI (MACF.) -- GULF STATES U.S.A.
 D. FILIPES (TURCS.) = ?
 D. FINLAYSONI (WALL.) = D. INDICA
 D. FINLAYSONIANA (WALL. EX STEIN) -- VIETNAM
 D. FLABELLATA (BENTH.) -- W. AUSTRALIA
 D. FLAGELLIFERA (COL.) = D. BINATA
 D. FLEXICULIS (WELW. EX OLIVER) -- TROPICAL AFRICA
 D. FOLIOSA (HOOK. F.) = D. PELTATA VAR. FOLIOSA
 D. FULVA (PLANCH.) = D. PETIOLARIS
 D. GIGANTEA (LINDL.) -- AUSTRALIA
 D. GLABRIPES (HARV.) -- S. AFRICA
 D. GLANDULIGERA (LEHM.) -- AUSTRALIA
 D. GRACILIS (HOOK. F.) = D. PELTATA VAR. GRACILIS
 D. GRAMINIFOLIA (ST. HIL.) -- BRAZIL
 D. GRANDIFLORA (BARTL.) = D. PAUCIFLORA
 D. HAMILTONI (C. ANDREWS) -- AUSTRALIA
 D. HELIANTHEMUM (PLANCH.) = D. CISTIFLORA
 D. HETEROPHYLLA (LINDL.) -- AUSTRALIA
 D. HEXAGYNA (BLANCO) = D. INDICA
 D. HILARIS (CHAM. ET SCHLECHTD.) -- S. AFRICA
 D. HIRTELLA (ST. HIL.) -- BRAZIL
 D. HUEGELII (ENDL.) -- AUSTRALIA
 D. HUMBERTII (EXELL ET LAUNDON) -- MADAGASCAR
 D. HUMILIS (PLANCH.) = D. STOLONIFERA VAR. HUMILIS
 D. X HYBRIDA (MACF.) = FILIFORMIS X INTERMEDIA -- N.J. U.S.A.
 D. INCISA (A. RICH.) -- CUBA
 D. INDICA (L.) -- ASIA, TROPICAL AUSTRALIA, S. AFRICA
 D. INSOLITA (TATON) -- BELG. CONGO
 D. INTERMEDIA (HAYNE) -- EUROPE, N. AMERICA, GUIANA
 D. KAIETEURENSIS (BRUMMER-DING.) -- GUIANA
 D. KATANGENSIS (TATON) -- C. AFRICA
 D. LEIONEHA (RAFIN.) = ?
 D. LEUCANTHA (SHINNERS) -- SE. STATES U.S.A.
 D. LEUCOBLASTA (BENTH.) -- AUSTRALIA
 D. LIGULATA (COL.) = D. ARCTURI
 D. LINEARIS (GOLDIE) -- N. AMERICAN BUREAL
 D. LONGIFOLIA = D. ANGLICA
 D. LOUREIRII (HOOK. ET ARN.) = D. SPATHULATA
 D. LOVELLAE (BAILEY) -- AUSTRALIA
 D. LUNATA (HAM.) = D. PELTATA VAR. LUNATA
 D. MACEDONICA (KOLANIN) -- MACEDONIA
 D. MACLOVIANA (GANDUGER) -- FALKLAND ISLANDS
 D. MACRANTHA (ENDL.) -- AUSTRALIA
 D. MACRANTHA VAR. BURGESSII (?)
 D. MACROPHYLLA (LINDL.) -- AUSTRALIA
 D. MADAGASCARIENSIS (DC.) -- MADAGASCAR, TRUP. AFRICA
 D. MAKINOI (MASAM.) = D. INDICA
 D. MARITIMA (ST. HIL.) -- BRAZIL
 D. MENZIESII (R. BR.) -- AUSTRALIA
 D. MENZIESII VAR. ALBIFLORA (BENTH.) = D. PLANCHONII

D. MERISTOCAULIS (MAGUIRE FT. MURDACH) = ?
 D. METZIANA (GANDUGER) -- INDIA
 D. MICROPHYLLA (ENDL.) -- AUSTRALIA
 D. MICROPHYLLA VAR. MACROPETALA (DIELS)
 D. MINIATA (DIELS) -- AUSTRALIA
 D. MINUTULA (COL.) = D. PYGMAEA
 D. MODESTA (DIELS) -- AUSTRALIA
 D. MONTANA (ST. HIL.) -- BRAZIL, VENEZUELA
 D. MONTANA VAR. ROBUSTA (DIELS) -- VENEZUELA
 D. MONTANA VAR. RURAIMAE (KLOTZSCH) -- VENEZUELA

 D. MYRIANTHA (PLANCH.) -- AUSTRALIA
 D. X 'NAGAMOTO' = ANGLICA X SPATHULATA -- HORT. (JAPAN)
 D. NATALENSIS (DIELS) -- S. AFRICA
 D. NEESII (LEHM.) -- AUSTRALIA
 D. NEO-CALEDONICA (HAMEY) -- NEW CALEDONIA
 D. NIPPONICA (MASAMUNE) = D. PELTATA VAR. LUNATA
 D. NITIDULA (PLANCH.) -- AUSTRALIA
 D. X OBOVATA (KOCH) = ROTUNDIFOLIA X ANGLICA -- ASIA
 D. OCCIDENTALIS (MORR.) -- W. AUSTRALIA
 D. OMISSA (DIELS) -- AUSTRALIA
 D. PALEACEA (DC.) -- AUSTRALIA
 D. PALEACEA VAR. TRICHUCAULIS (DIELS)
 D. PALLIDA (LINDL.) -- AUSTRALIA
 D. PARVIFOLIA (ST. HIL.) -- BRAZIL
 D. PARVULA (PLANCH.) -- AUSTRALIA
 D. PAUCIFLORA (BANKS EX DC.) -- S. AFRICA
 D. PAUCIFLORA VAR. MINOR (SUND. IN F.C.) = D. CISTIFLORA
 D. PEDATA (PERS.) = D. BINATA
 D. PELTATA (SM. EX WILD.) -- AUSTRALIA, JAPAN, FORMOSA
 D. PELTATA VAR. FOLIOSA (HOOK. F.) -- S. QUEENSLAND
 D. PELTATA VAR. GRACILIS (HOOK. F.) -- S. QUEENSLAND
 D. PELTATA VAR. LUNATA (CLARKE) -- JAPAN, FORMOSA
 D. PENICILLARIS (BENTH.) -- W. AUSTRALIA
 D. PETIOLARIS (R. BR. EX DC.) -- AUSTRALIA
 D. PILOSA (EXELL ET LAUNDON) -- CAMEROONS, KENYA, TANGANYIKA
 D. PLANCHONII (HOOK. F. EX PLANCH.) -- AUSTRALIA
 D. PLATYPODA (TURCZ.) -- AUSTRALIA
 D. PLATYSTIGMA (LEHM.) -- AUSTRALIA
 D. POLYNEURA (COL.) = D. ARCTURI
 D. PRAEFOLIA (TEPPER) = D. WHITTAKERI VAR. PRAEFOLIA
 D. PREISSII (LEHM.) = ?
 D. PROLIFERA (C.T. WHITE) -- QUEENSLAND AUSTRALIA
 D. PROPINQUA (R. CUNN.) = D. SPATHULATA
 D. PULCHELLA (LEHM.) -- AUSTRALIA
 D. PUSILLA (H.B.K.) -- VENEZUELA
 D. PYCNOBLASTA (DIELS) -- AUSTRALIA
 D. PYGMAEA (DC.) -- AUSTRALIA, NEW ZEALAND
 D. RAMELLOSA (LEHM.) -- AUSTRALIA
 D. RAMENTACEA (BURCH. EX DC.) -- S. AFRICA
 D. RAMENTACEA VAR. GLABRIPES (HARV. EX PLANCH.) = D. GLABRIPES
 D. REGIA (STEP.) -- S. AFRICA
 D. ROSULATA (BEHR.) = D. WHITTAKERII
 D. ROSULATA (LEHM.) -- AUSTRALIA
 D. ROTUNDIFOLIA (L.) -- N. HEMISPHERE
 D. ROTUNDIFOLIA X INTERMEDIA (CALLIER) -- U.S.A.
 D. RUAHINENSIS (COL.) = D. ARCTURI
 D. RUBIGINOSA (HECKEL) -- NEW CALEDONIA
 D. SANARIAPOANA (STEYERMARK) = D. CAYENNENSIS
 D. SCHIZANDRA (DIELS) -- AUSTRALIA
 D. SCORPIOIDES (PLANCH.) -- AUSTRALIA

D. SERPENS (PLANCH.) = D. INDICA
 D. SESSILIFOLIA (ST. HIL.) -- BRAZIL, GUIANA
 D. SEMELLIAE (DIELS) -- AUSTRALIA
 D. SPATHULATA (LABILL.) -- AUSTRALIA, NEW ZEALAND, JAPAN
 D. SPECIOSA (PRESL) = D. CISTIFLORA
 D. SPIRALIS (ST. HIL.) -- BRAZIL
 D. SQUAMOSA (BENTH.) -- AUSTRALIA
 D. STENOPEOTALA (HOOK.) -- NEW ZEALAND
 D. STOLONIFERA (ENDL.) -- AUSTRALIA
 D. STOLONIFERA VAR. HUMILIS ((PLANCH.) DIELS)
 D. STRICTICaulis (O.H.S.) -- AUSTRALIA
 D. STYLOSA (COL.) = D. AURICULATA
 D. SULPHUREA (LEHM.) -- AUSTRALIA
 D. SUBHIRTTELLA (PLANCH.) -- AUSTRALIA
 D. SUBHIRTTELLA VAR. MOUREI (DIELS)
 D. TENELLA (H.B.K.) -- ARGENTINA
 D. TENELLA VAR. ESMERALDAE (STEYERMARK) = D. CAPILLARIS
 D. THYSANOSEPALA (DIELS) -- AUSTRALIA
 D. TOMENTOSA (ST. HIL.) -- BRAZIL
 D. TRACYI = D. FILIFORMIS F. TRACYI
 D. TRIFLORA (COL.) = D. SPATHULATA
 D. TRINERVIA (SPRENG.) -- S. AFRICA
 D. UMBELLATA (LOUR.) -- CHINA
 D. UNIFLORA (WILLD.) -- S. AMERICA
 D. VIOLACEA (WILLD.) = ?
 D. VILLOSA (ST. HIL.) -- BRAZIL
 D. WHITTAKERII (PLANCH.) -- AUSTRALIA
 D. WHITTAKERII VAR. PRAEFOLIA ((TEPPER) BLACK) -- S. AUSTRALIA
 D. ZEYHERI (SALTER) = D. CISTIFLORA
 D. ZONARIA (PLANCH.) -- AUSTRALIA

SMALLER GENERA

HELIAMPHORA

H. HETERODOXA (STEYERMARK) -- MOUNT PTARI-TEPUI, VENEZUELA
 H. MACDONALDAE (GLEASON) -- MOUNT DUIDA, VENEZUELA
 H. MINOR (GLEASON) -- MOUNT AUYAN-TEPUI, VENEZUELA
 H. NUTANS (BENTHAM) -- MOUNT RORAIMA, VENEZUELA
 H. TATEI (GLEASON) -- MOUNT DUIDA, VENEZUELA
 H. TYLERI (GLEASON) -- MOUNT DUIDA, VENEZUELA

ALDROVANDA VESICULOSA (L.) -- EUROPE, INDIA, JAPAN, AFRICA

BYBLIS GIGANTEA (LINDL.) -- AUSTRALIA

BYBLIS LINIFLORA (SALISB.) -- AUSTRALIA

CEPHALOTUS FOLLICULARIS (LABILL.) -- AUSTRALIA

DARLINGTONIA CALIFORNICA (TORR.) -- CALIFORNIA, OREGON

DIONAEA MUSCIPULA (ELLIS EX L.) -- E. U.S.A.

DRUSOPHYLLUM LUSITANICUM (LINK.) -- SPAIN

